POPULAR SCIENCE

OCTOBER

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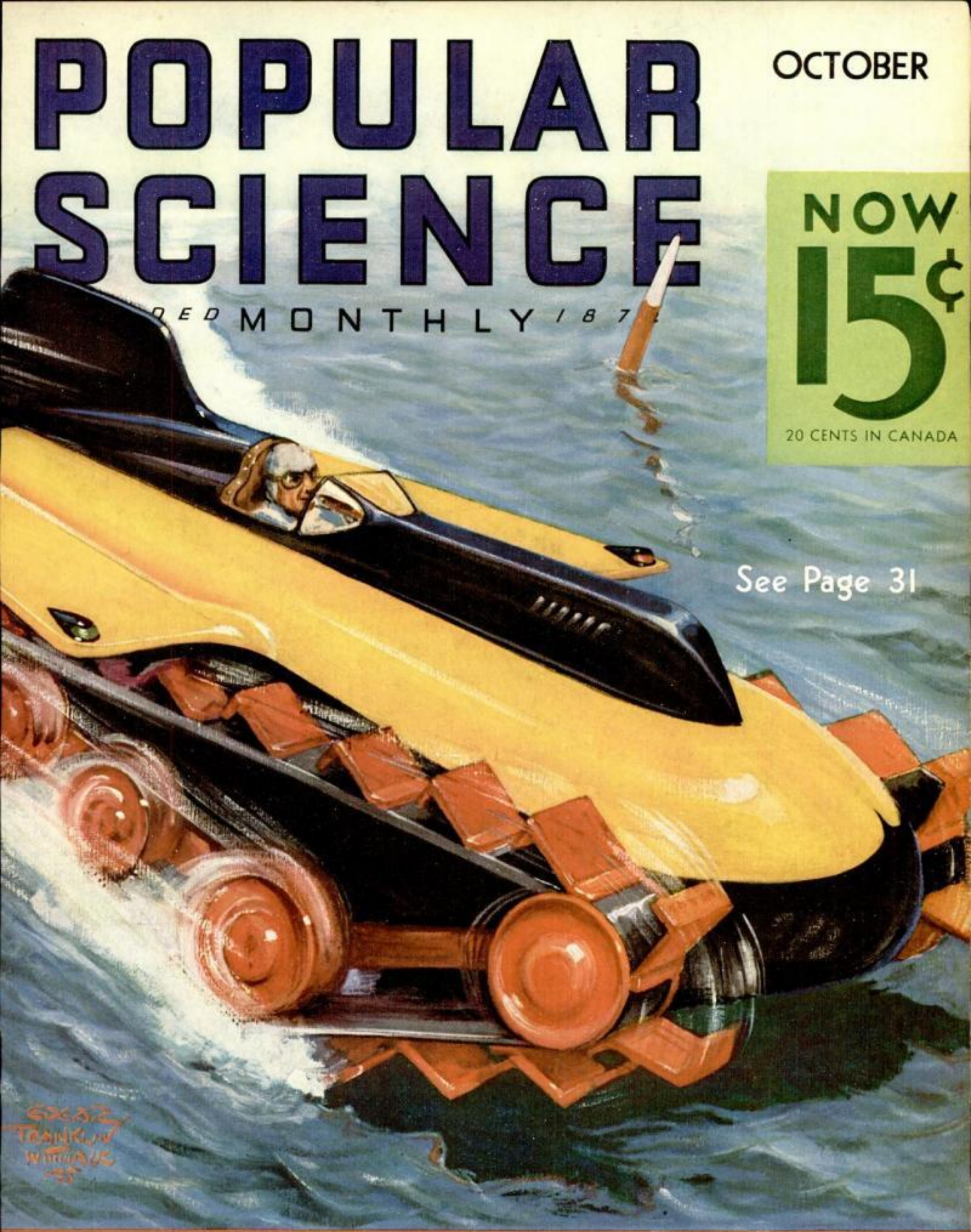

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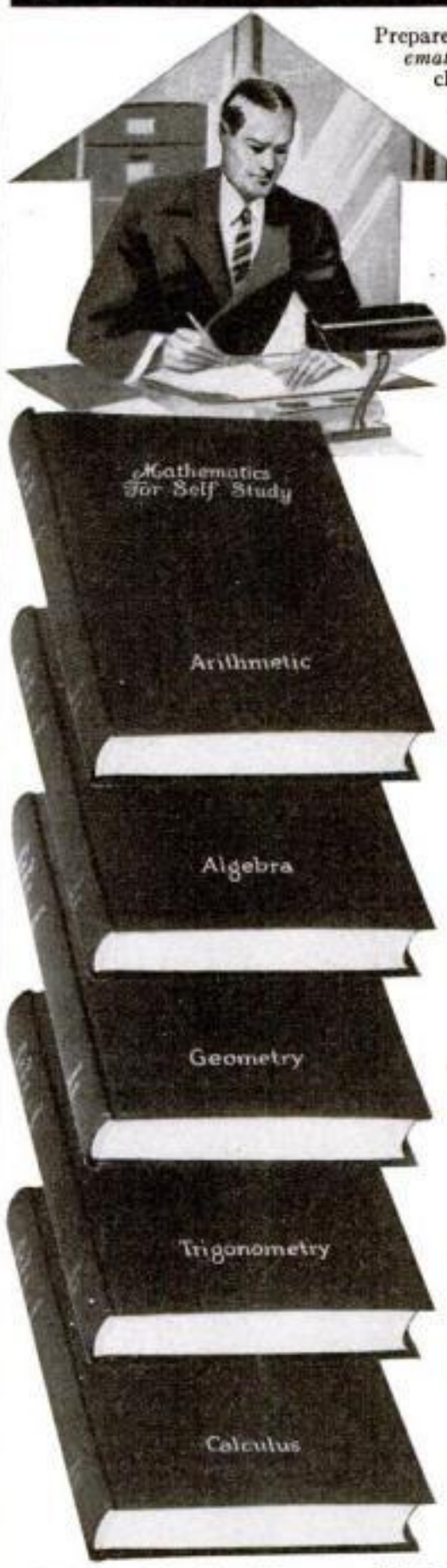

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POPULAR SCIENCE

FOUNDED MONTHLY 1872

VOLUME 127 · NUMBER 4
15 Cents a Copy · $1.50 a Year
Published Monthly by
Popular Science Publishing Co., Inc.,
353 Fourth Ave., New York

TABLE OF CONTENTS for OCTOBER, 1935

October, 1935, Vol. 127, No. 4. **Popular Science Monthly** is published monthly at 353 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. A. L. Cole, President and Treasurer; R. C. Wilson, Vice President; John Nichols, Vice President; F. W. Briggs, Sec'y. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A.

Single copy, 15 cents (20 cents in Canada). Yearly subscriptions to United States and its possessions $1.50; foreign countries, including Canada, $2. Subscribers must notify us of change of address four weeks in advance of the next publication date. Be sure to give both old and new address. The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. Contributions not accompanied by sufficient postage will not be returned. In presenting numerous stories of new products of applied science, **Popular Science Monthly** does not underwrite the business methods of the individuals or concerns producing them. The use of **Popular Science Monthly** articles for stock-selling schemes is never authorized.

FEATURES AND DEPARTMENTS

Cover Design by EDGAR F. WITTMACK

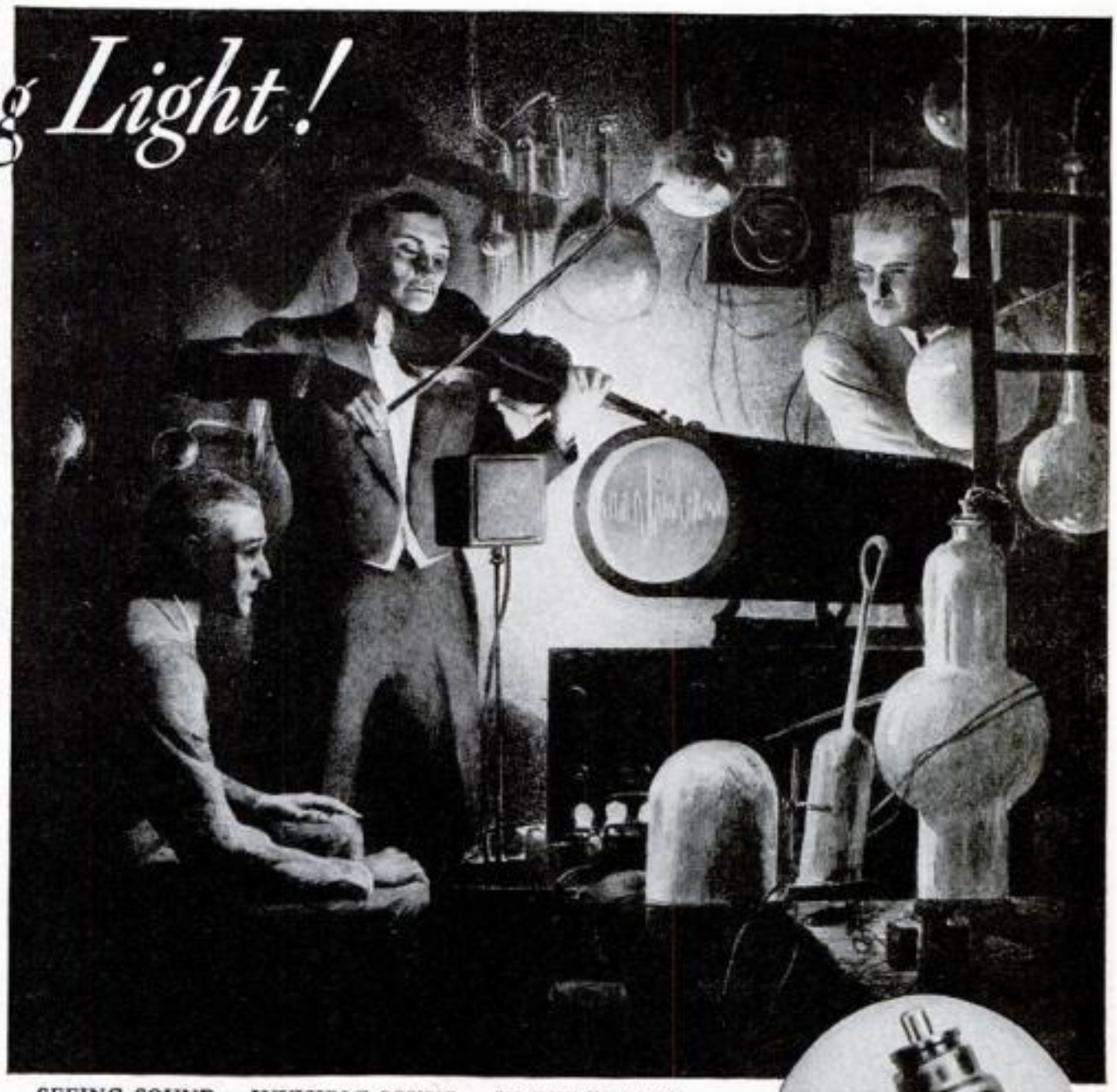
AUTOMOBILES

AVIATION

HEALTH AND HYGIENE

They changed a CHOPIN WALTZ into Dancing Light!

AND OUT OF THE "HOUSE OF MAGIC" CAME A RADIO MIRACLE



SEEING SOUND... INVISIBLE SOUND... IN THE "HOUSE OF MAGIC"! They don't trust the human ear, in the G-E Research Laboratory, to gauge the purity of radio tone. Instead they have devised ingenious instruments that change spoken words, bars of music into waves of green light. Thus, the hidden secrets of sound are revealed... the causes of unwanted noises discovered—and eliminated.

THIS YEAR, radio is different... wonderfully different!

Scientists in the General Electric "House of Magic" have made it so ... with smaller, more dependable tubes of enduring steel.

New metal tubes* that have silenced forever the annoying crackle caused by "shielding cans"... subdued the microphonic twang that clouds reception.

The inspiration for a new radio

Today, you may enjoy all the advantages of these sturdy metal tubes ... their long life, their performance lastingly brilliant ... in a completely new receiver—

The New 1936 General Electric Radio.

But that's not all!

In soundproof rooms ... where the blood beats against your eardrums like the pounding of the surf... the Stabilized Speaker was born ... a supremely sensitive speaker that reproduces speech and music with all their naturalness and tonal color.

Truly—a perfect sound-mate for the new metal tubes!

A radio always at "Concert Pitch"

And this superb tone remains constant... thanks to the Permaliner, which maintains the original alignment of the radio ... keeping the set at "concert pitch" year in and year out.

Perhaps most dramatic of all is the Sentry Box ... controlling as many as five separate broadcasting bands ... headquarters of a mystic sentinel that you'd expect to find only in "The Arabian Nights."

He is stormed by a thousand and one radio waves—all demanding entrance. But he permits only *one* wave to pass—the one to which your set is dialed. All others must keep out—and keep silent.

To the new General Electric Radio, these exclusive "House of Magic" features give a brilliance and fidelity of tone that will delight the most exacting ears.

Performance lastingly brilliant

They give, as well, another quality that you'll appreciate more and more with the passing of time—a *lasting* brilliance of performance that defies the years.

The New 1936 General Electric Radio is now on display at your nearest G-E Radio Dealer's. In many smartly styled models—table sets and consoles. Priced from $34.50. (Prices slightly higher in the West, Mid-West and South, and subject to change without notice.)

See them! Hear them! You'll find they speak for themselves ... with a charming persuasiveness no words can match.

**Metal radio tubes, invented and perfected by General Electric, are made for General Electric by the RCA Mfg. Co. Complete receivers built by General Electric at Bridgeport, Conn.*

Sets that make the world your radio playground ... from $34.50 up!

MODEL A-125—Twelve-tube, 5-band superheterodyne, completely equipped with metal tubes. Walnut cabinet of neo-classic design.

NEW METAL TUBES... small, efficient, long-lived... designed to meet modern broadcasting conditions, short-wave and long-wave alike.

The new 1936 GENERAL ELECTRIC RADIO

POPULAR SCIENCE MONTHLY FOR OCTOBER, 1935

MODELS

NEW PROCESSES AND INVENTIONS

PHOTOGRAPHY

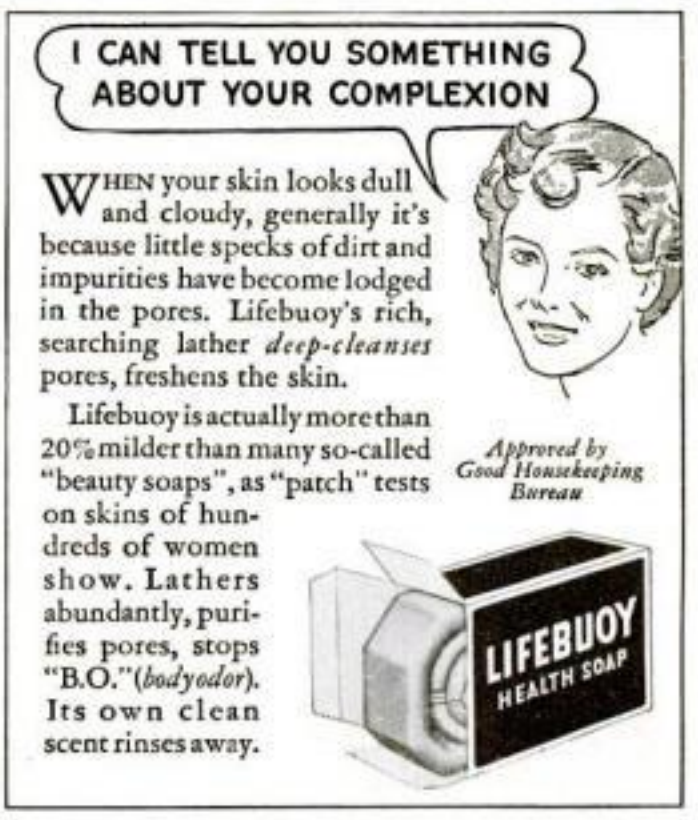
UNUSUAL FACTS AND IDEAS

CRAFTWORK

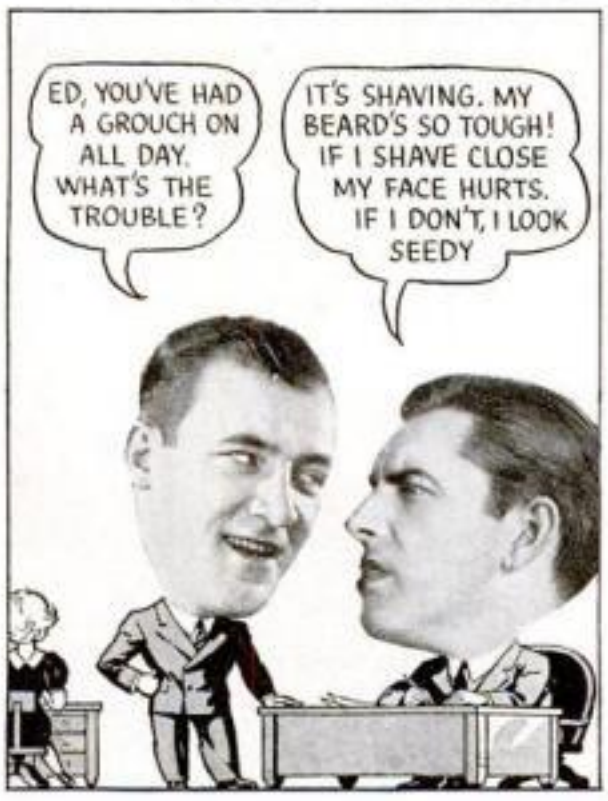
ONE of Britain's new "pocket submarines," H.M.S. Sealion. *This is one of the modern undersea fighting craft described in an article on page 22*

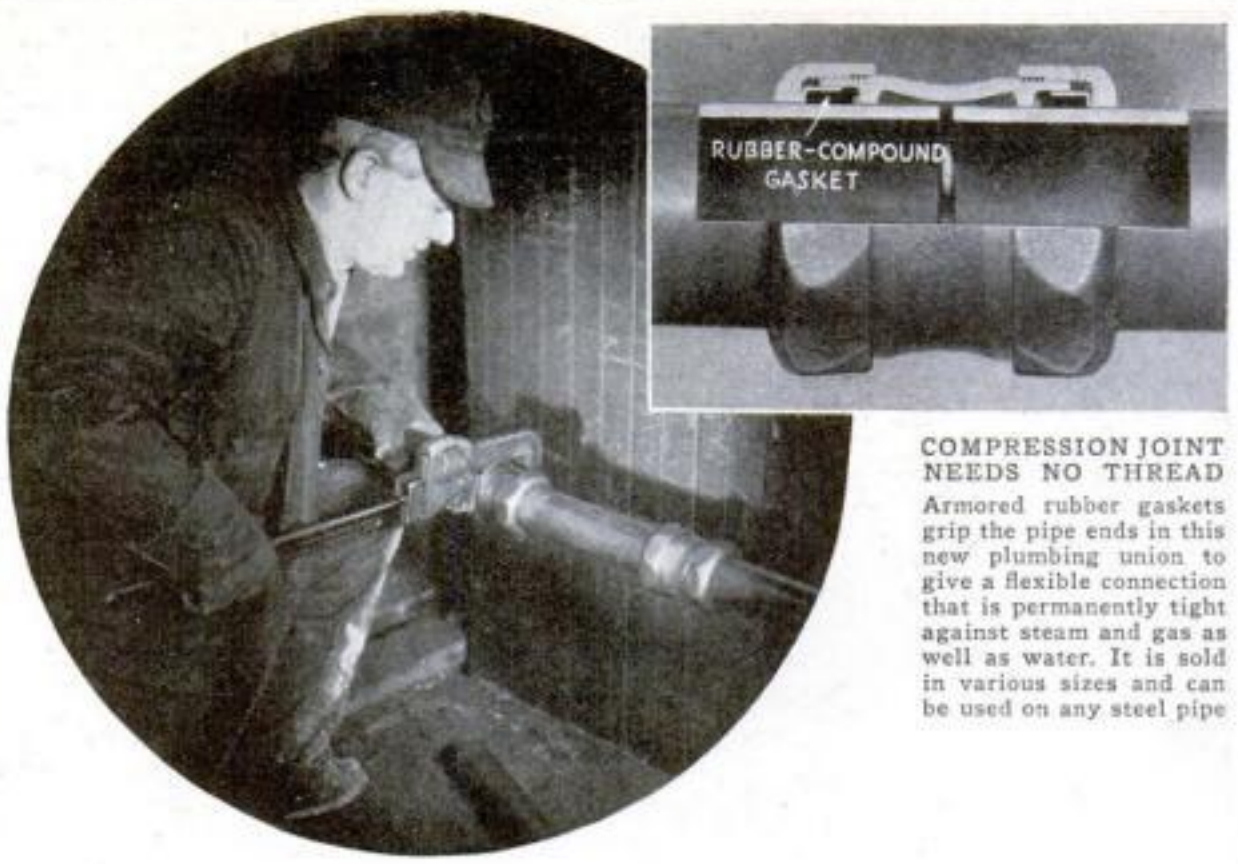
IDEAS FOR THE HANDY MAN

NO NEED TO BE JEALOUS OF HIM!



THE REAL "LOW-DOWN" ON SHAVING



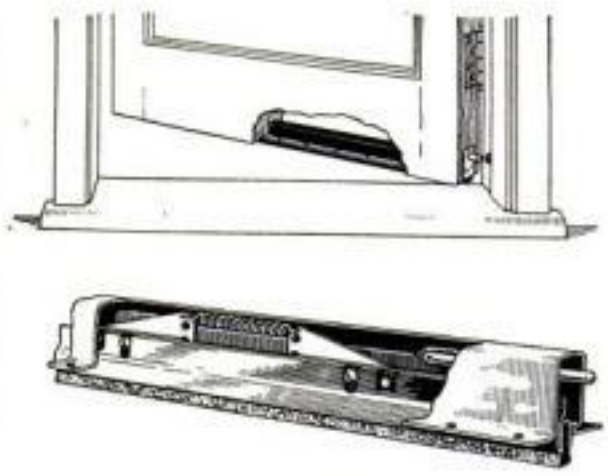


COMPRESSION JOINT NEEDS NO THREAD

Armored rubber gaskets grip the pipe ends in this new plumbing union to give a flexible connection that is permanently tight against steam and gas as well as water. It is sold in various sizes and can be used on any steel pipe

New Ideas *for* Home Mechanics

NO BULKY and expensive threading tools are needed to make pipe repairs and improvements when the new compression-type coupling shown is used. These novel, self-contained pipe joints can be applied easily to plain-end pipe to give a flexible yet permanent connection. A wrench is the only tool required for the work. Two armored, rubber-compound gaskets, forced in as the ends of the coupling are tightened, grip the pipe ends to form a union that is leak-proof against steam and gas as well as water. Sold in a variety of sizes, they can be used wherever steel pipe is employed.



SPRING WEATHERSTRIPPER SEALS DOOR BOTTOM

Being entirely automatic in operation, a new weatherstripping device for interior doors insures a tight fit between the floor or threshold and the bottom of the door. It is designed especially for use on bedroom doors where a good air seal is needed in winter to prevent the cold air from open windows from cooling off the rest of the house. As shown in the cutaway view, the weatherstripper is installed in a narrow groove cut in the bottom edge of the door. A pin projecting from the hinge edge of the door strikes a stop in the jamb when the door is closed. This forces a piece of soft weatherstripping into snug contact with the floor and provides a tight seal. Because it is spring-controlled, the weatherstripping cannot bind and it adjusts itself to any irregularities in the floor. According to its manufacturers, the fuel saved through the use of one of these spring bottoms on a bedroom door will pay for the installation in sixty days.

STEEL SHINGLES FOR OLD OR NEW ROOFS

With the increased use of steel for decorative as well as constructional purposes in the small home, shingles of thin steel are fast gaining in popularity. They can be applied over existing wood shingles or on the sheathing of a new roof with equal ease and their rigidity and special locking edges provide a durable, sag-proof roof.

TRANSPARENT COMPOUND WATERPROOFS SURFACES

PROVIDING protection against moisture for almost any porous surface, a new transparent waterproofing compound recently developed can be applied with either a brush or a spray gun. It can be used to damp-proof wood, brick, concrete, canvas, rope, stone, and a score of other materials, making it a useful addition to the home owner's paint shelf. Even auto tops, shingles, trunks, and tents can be waterproofed with the colorless mixture and when applied on stucco it prevents disintegration. It also can be mixed with paint for application as illustrated. Marketed as a liquid in cans, it can be applied at any temperature.

Questions
FROM HOME OWNERS

Q.—WHAT is the best method of ridding a house of red ants?—T.F.D., Trenton, N. J.

A.—A method tested by the Bureau of Entomology, U. S. Department of Agriculture, consists of making a solution by dissolving one pound of sugar in one quart of water and adding 125 grains of arsenate of soda (a poison). This mixture then should be boiled and strained. When it is cool, dip a few small sponges into the sirup and place them where the ants can get at them. When they are covered with ants, dip them in boiling water, redip them in the sirup solution, and repeat the operation. The boiling water will kill any ants not already dead from the poison.

Right Height for Steps

R. S., LOS ANGELES, CALIF. In properly designed steps, the rise, or height from one step to the next, is generally eight or eight and one quarter inches. If a larger rise is necessary, the width of the step should be less.

Cutting Glass to Fit

H. P., CHICAGO, ILL. When cutting small panes of glass to shape, it is best to place the glass right over the frame so that the glass cutter can be run directly over the edge. Experienced cutters can follow the line by eye, but the amateur should use a straightedge.

Our Readers Say

Automobile Tire Tube Is Life-Saver to Tropical Fish

In a recent issue of your magazine, F. M., of Brooklyn, N. Y., asked how he could make a mechanical aërator for a tropical-fish tank. The simplest and most effectual aërator I have seen is made from the inner tube of an automobile tire, a long piece of rubber tubing, and a piece of wire. After inflating the tube, the valve is unscrewed slightly to permit a small leak and then the rubber tubing is forced on the valve stem. The wire is fashioned into two loops with a hook bent into one end. The hook fastens to the side of the tank and the rubber tube is passed through the loops. If the tubing is supported so that the end of it rests in the center of the tank, this arrangement will aërate the water sufficiently for most of the species of tropical fish kept by amateurs. The apparatus can be made more efficient if a short piece of glass tubing, which has been drawn to a point on one end, is inserted in the tank end of the rubber tube.—F.S.H., Jerseyville, Ill.

When Opposing Lawyers Use Same Ammunition

William Wolf's article on poisons and their analysis in connection with crime was most interesting and informative. However, when he states that there is a positive test for blood stains, I wonder. In the David Lamson murder case tried for the second time this spring at San Jose, Calif., both the prosecution and the defense experienced difficulties when the question of positive blood tests was encountered. Most of the tests mentioned in Mr. Wolf's article were used both by the state and the defense. When the state experts were on the stand, a particular test would, it seemed, prove beyond doubt that the stain was blood but when the defense experts testified, the blood test did not appear to be conclusive proof. Is there really a positive test for blood stains?—R.G.B., Palo Alto, Calif.

You'll Probably Get It In Cellophane Wrappers

Been hearing quite a bit lately about "solene," the recently developed solid gasoline, and its many advantages over the well-known liquid type. What gets me is how service stations are going to take care of filling automobile gas tanks with the stuff. Will gas tanks have to be designed like air-tight refrigerators with large hatches or doors? How will the station attendant sell five gallons (or will it be cubic feet)? Or will he cut it from a huge cake like an ice man does ice?—G.S., Chicago, Ill.

Just an Instance Where Nature Took No Chances

Apropos of the question raised by E.F.C., of New York City about why we involuntarily jump or give a start at any unexpected loud noise, I would like to submit my opinion. Mother Nature didn't trust the much-touted wisdom of man any too far. So she outfitted him with a set of reflexes which work independently of his will. Messages coming from the nerve endings must pass through the spinal cord. Any unexpected message of pain or alarm, instead of proceeding to the brain, merely jumps a gap between the sensory and motor nerves in the spinal column. This saves times and gets more effective results. Even though the ears are close to the brain, the message they send must make the spinal-cord circuit where it is intercepted and made a reflex in the case of unexpected alarms.—I.H., Worcester, Mass.

Visits South America With One-Tube Set

Every issue of your magazine during the past three years (that is the time I have been taking it) has been a good one. I like most of all the articles on model building and radio. I built the one-tube set described in the June, 1934, issue and I have had Bogota, Colombia, several times. Reception was as good as with a four-tube set. I have many other distant stations on my log. Please keep the magazine as it is and disregard the displeased.—U.L., Valdosta, Ga.

He Wants To Call A Spade a Spade

The small item in your September issue bringing out the fact that there is no cat in catgut set me to thinking about a lot of other English words that don't mean what they say. For instance, there is no lead in a lead pencil. Most trolley cars have no trolleys but under-rail shoes. A file card isn't a card at all, but a wire brush. The center of gravity is rarely central, and nickel coins contain about three times as much copper as they do nickel. We strive for accuracy in business and science, why not a little accuracy in our words?—G.D.S., Boston, Mass.

Raises His Voice In Defense of Vivisection

In the August issue of the magazine, B.McK., of Australia appeared to look upon vivisection as a detestable practice. Without this research upon lower animals, however, medical and surgical science would suffer a great loss. Although much time and money has been spent upon cancer research via vivisection, it has not gone to waste. I believe in a few short years the true virtue of these experiments will yield a profit to all mankind. Many lower mammals have fundamentally the same structure as man, so that research with animals can very well be used in the fight on human diseases.—S.Z., Darby, Pa.

Seat Covers Cause This Woman To Rise and Remark—

Well, Mr. Editor, get on the defensive because I am after you. And from my viewpoint, there is no defense. I'm writing about that article in your Helpful Hints for Motorists telling of the use of not one set of seat covers but two! Of all things. Putting one set of seat covers over the upholstery in a car is, in my estimation, an absurd act. It is about as sensible as a man who, after buying an expensive and stylish suit, always donned overalls and jumper when wearing it. We buy certain things in this world for their beauty as well as their utility. We are both stimulated and rested by colors and designs. Skilled workers in all branches of art strive to give us the best combination of these factors in many of the things we use. Automobile upholstery is one of them. I say out with your prison-stripe seat coverings!—Mrs. L.M.K., Paterson, N. J.

Answers Call for Cement To Fix Sun-Ray Bulbs

S.B.K., of Youngstown, Ohio, asked in the August issue for a cement which would fasten a loosened sun-ray lamp bulb to its socket. I would suggest the following: Mix litharge with glycerin until you have a mixture of thick paintlike consistency. This will hold the bulb tightly in place.—C.R., Queens Village, N. Y.

A Bird in the Jar Stirs Up Complications

Referring to your recent Here's-the-Answer item, titled "A Matter of Weight," the problem involved is not as simple as it might appear from that paragraph. A bird flying into a large jar and around inside without touching the sides of the jar would create, I think, a problem of wind pressure from the flapping of the wings rather than one of simple weight increase. Should the bird, in circling the jar, attain a high rate of speed, its position would approximate a ninety-degree bank, with all the pressure exerted against the side walls of the jar in a horizontal direction. How would that affect the weight (vertical pressure—weight on a

scale) of the jar itself? The problem seems to require plenty of calculus for its solution. A somewhat similar problem is created when a bicycle rider circles a vertical cylinder at a speed which enables him to maintain a course around the inner circumference of the cylinder. Does centrifugal force exerting horizontal strains and stresses reduce the vertical components—weight of wheel and rider? For this I may incur the wrath of your mathematical sharks.—H.S.R., New Rochelle, N. Y.

Choose Your Weapons! He'll Take Swords

NOT to be outdone by other readers, I've decided to put in a word or two about what I would like to see published in the magazine. How about a few articles on swords and fencing? There's plenty of science to the art of defending yourself with rapiers and foils. To acquire the technique of an expert fencer requires good instruction and much practice. Drawings illustrating the various defenses and parries would be interesting and instructive. And, as a side light, there is the story of the manufacture of high-grade swords which is dependent on chemistry and metallurgy.—J.H., Brooklyn, N. Y.

In Which Case the Nose May Not Always Know

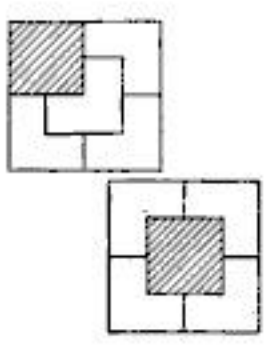
I WISH some enterprising scientist would give us the low-down on the sense of smell. What is it—a chemical function or a nerve reaction like the sense of touch? According to recent tests, the sense of smell varies with the individual. What strikes one person as being a pleasant smell often is unpleasant to others. I for one, for instance, see nothing unpleasant in the whiffs of skunk you get as you drive along a country road at night. On the other hand, many flowers known for their heavy perfume are odorless as far as I am concerned.—T.D.V., New Haven, Conn.

P. S. M. Chairs Set Well In Rustic Surroundings

I WANT to show my appreciation and tell you that your magazine certainly makes people happy. Recently I made several garden chairs of which the design, description, and particulars were given by Herman Hjorth. The chairs were made for a friend who has a bungalow at a Connecticut lake. In such a setting the chairs appear right at home. Please continue to give us more articles by Mr. Hjorth.—J.V.H., Riverdale, N. Y.

Here's How, Says Philippines To Australia

THE problem of T.H.W., of Bexley, Australia, interested me very much and I hope to see more problems like it. I am enclosing sketches, giving my solution which meets all the required conditions. The problem stated that a farmer died, leaving four sons to inherit his farm which was square in shape. The conditions were that one quarter (a square) should be left for the homestead and the remainder divided among the four sons so that each would have a plot the same size and shape as the others.—B.D.M., Pangasinan, Philippine Islands.



Where Your Money Goes Up in Smoke

"IF WINTER comes," was a thought which entered my mind the other day so I was moved to go down in the cellar and take a look at the furnace—with a furtive glance thrown in the direction of the empty coal bin. Well, the old boiler, after a soot-removal job, will probably carry on through another season. Further, that trip into the cellar prompted the writing of this letter. The message which I wish the editor to relay before some of his ingenious readers is this: Most of the heat generated in a home furnace is wasted and only a small percentage gets into the house-heating system even though it is kept in tip-top condition. With the approaching widespread use of air-conditioning for homes, there should be a great incentive to develop a combination heating and cooling unit which has a relatively high efficiency and which can be produced at a price within reach of the average householder. This is no new idea but I believe it is a tempting thought to lay before your amateur wizards of chemistry, physics, electricity, and mechanics. I hope some one gets busy on this problem as quickly and successfully as your puzzle-solvers apparently go to work.—C.F., Rutland, Vt.

Civilian's Daily Flights Make Reader Air-Minded

YOUR article last month about Dr. John D. Brock and his daily flights interested me mightily. Here is a man who has really done something for aviation. Hopping the oceans and circling the globe are thrilling stunts but they do not make the average man want to fly. Penetrating the stratosphere in metal gondolas may make history and aid science but it still leaves John Citizen wanting to keep one foot on the ground. Now comes Dr. Brock. For six years, every day in the month and every month in the year, he sails into the air on his regular hop. For 2,000 consecutive days, he has flown at least once. And all this without a serious accident. Nothing I have ever read before made me realize the safety of aircraft today as much as that story.—R.N., Denver, Colo.

Well, He Needn't Worry About the Change

JOHN D. ROCKEFELLER, SR., recently entered into his ninety-seventh year. The September issue of POPULAR SCIENCE MONTHLY carried an article telling that a German had developed an automobile which operates with wood for fuel as well as gasoline. These two news items, coming so close together, seem noteworthy to me. Will the elder Rockefeller, who has lived to see the petroleum industry grow from its pre-motor infancy to its present gigantic size, live to see petroleum supplanted as the greatest source of power? It seems to me that fuel from some form of cellulose is a rational possibility for the not distant future. These two events, at least, graphically call to our attention the swift strides that science has taken in one man's lifetime.—D.C., Oil City, Pa.

Only One Cube Escaped The Painter's Brush

MY ANSWER to the problem of E.H., of Des Moines, Iowa, is—sure, I can do it! The problem stated that small cubes were arranged into a solid larger cube so that each face of the large cube presented the sides of nine of its component small cubes. Then a coat of paint was applied to the exterior of the large cube and the question was to state how many of the small cubes were painted on three sides, how many on two sides, etc. Here it is: Eight cubes were painted on three sides, twelve on two sides, six on one side, and one was left unpainted.—N.C.C., Cleveland, Ohio.

There's a Time and Place For Everything, He Learns

I HAVE one objection to P.S.M., and that is—it's so interesting that many a time I get into trouble for reading it at the wrong time. Just the other day on my way home from work, I stopped at a newsstand and bought the latest edition. As soon as I was home, I sat down and began to read the magazine. Dinner was being prepared and I was asked to watch a pan of fish frying on the stove. During the next few minutes, my thoughts were concentrated on the magazine and not on the fish. I will spare you the scene that ensued but the net result, for me, was no dinner and some scorching reminders of how I had erred.—M.A.S., Baltimore, Md.

Would Hang a Crape On Decimal System

THE other day, in reading an old issue of POPULAR SCIENCE MONTHLY, I came across a letter in which the reader proposed a system of measurement having a unit equal to twenty-five inches divided into 100 parts. May one humbly ask why, if we are to make some change which will rationalize our system of weights and measures, we do not try the sexagesimal system? We already have it in universal use for the measurement of time and the division of the circle and earth's surface into angles. The decimal systems render it simpler to multiply various units but how about division? Sixty has more even divisors than 100 and twelve has more than ten. By adopting a sexagesimal system, we could discontinue the use of our statute mile and use the geographical mile which not only corresponds to one minute of longitude or latitude at the equator but is also nearly equal to 6,000 feet. The foot could be increased by one seventy-fifth of its present length so that 6,000 feet *would* equal a geographical mile. This mile is always used at sea and by geographers. Our bushel, so little over one cubic foot in capacity, might be abandoned and the cubic foot substituted as our unit of dry measure.—W.F.L., Sioux Falls, S. Dak.

Here's A Suggestion for An Appealing Alarm Clock

A MAN who won a hog-calling contest out here attributed his success to hog appeal in his voice. He said he seemed to promise the porkers something when he called. There's a tip for inventors. When an alarm clock rings in the morning, it just wakes you up. It doesn't have any appeal. It doesn't make you want to hop out of bed and come running. It just bings or bongs or buzzes. Why not substitute a phonograph-disk arrangement to shout "breakfast" or "come" and get it?" Or, why not have an aroma like hot coffee or bacon and eggs arise when the bell rings? Putting appeal in the alarm clock—there's a challenge!—E.B.A., Springfield, Ill.

YOUR EYE may be fooled by a "bargain" lamp, but the electric eye tells the truth. This marvelous scientific instrument proves conclusively that Edison MAZDA lamps *stay brighter longer* than lamps of inferior make—that they give more light for every dollar's worth of electricity consumed.

People are apt to forget that the true cost of light is the cost of the bulb *plus* the cost of the electricity it uses. And a lamp that uses $1.50 worth of current to produce a dollar's worth of light is no bargain, even if you get it for nothing.

There's just one safe course to follow when you buy lamps—look carefully at the trade-mark on the bulb. If you find this monogram GE on the end of the bulb you may rest assured that you are buying good light at low cost.

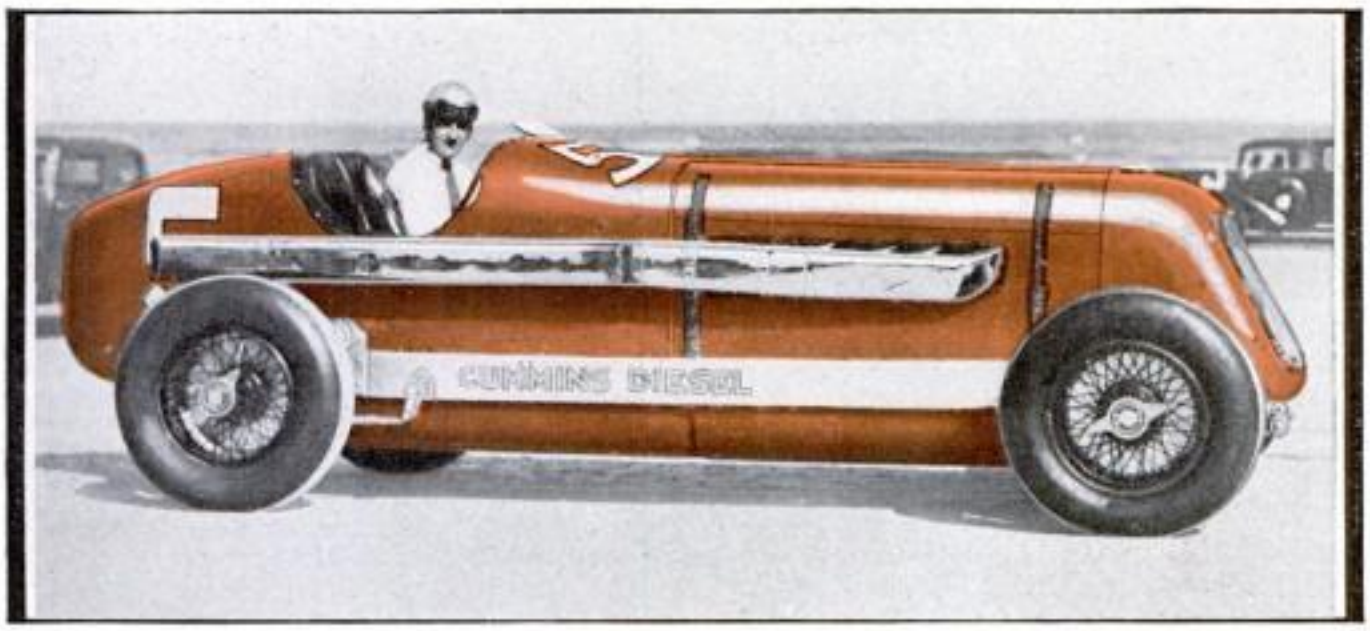
Get a supply of these good lamps today. Prices are lowest ever—only 15¢ for popular household sizes. And you can buy the comfortable reading sizes, 75 and 100-watt for only 20¢. General Electric Company, Nela Park, Cleveland, Ohio.

Both of these lamps are rated 60-watts, which means that they are designed to use the same amount of current. But notice the wide difference in the light they give as measured by the electric eye. Edison MAZDA lamps do stay brighter longer, and no wonder! 480 different checks and inspections guard them against the smallest imperfections.

POPULAR SCIENCE Monthly

OCTOBER 1935 VOL. 127 No. 4

RAYMOND J. BROWN, Editor



FASTEST DIESEL ON LAND

In a Diesel-powered racing car, C. L. (Wild Bill) Cummins reached the speed of 137 miles an hour at Daytona Beach, Florida—a record for this type of motor

By EDWIN TEALE

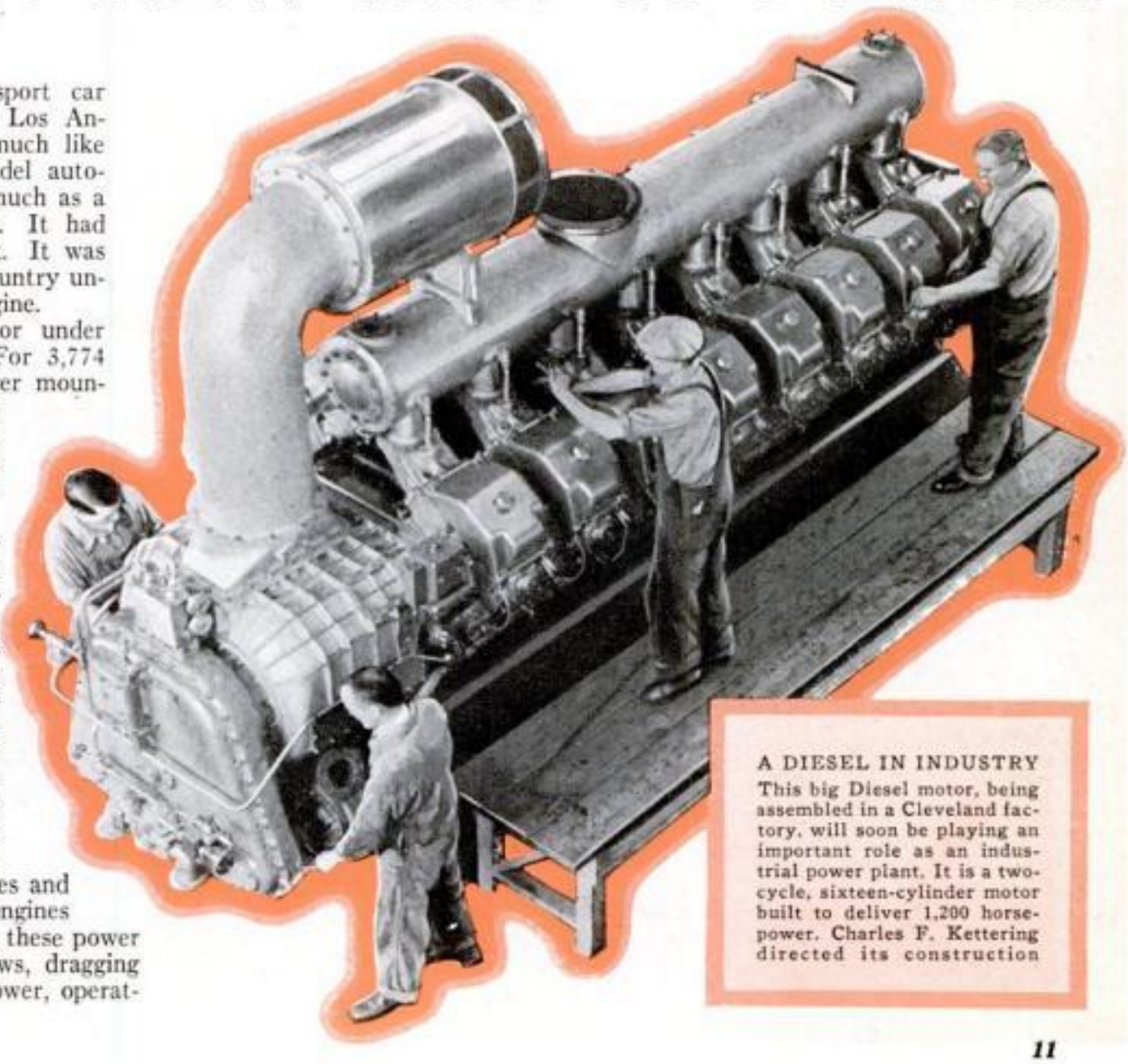
Diesel Engines USHER IN NEW AGE OF POWER

THE other day, a red sport car rolled down a street in Los Angeles, Calif. It looked much like any other sleek 1935-model automobile. Yet, it was a pioneer as much as a covered wagon of the early days. It had blazed a trail from coast to coast. It was the first automobile to cross the country under power supplied by a Diesel engine.

The six-cylinder Cummins motor under its hood ran on heavy fuel oil. For 3,774 miles, it had sent the machine over mountains, through forests, across prairies. And the total cost for fuel was only $7.63—less than the price of a railroad ticket from New York to Boston!

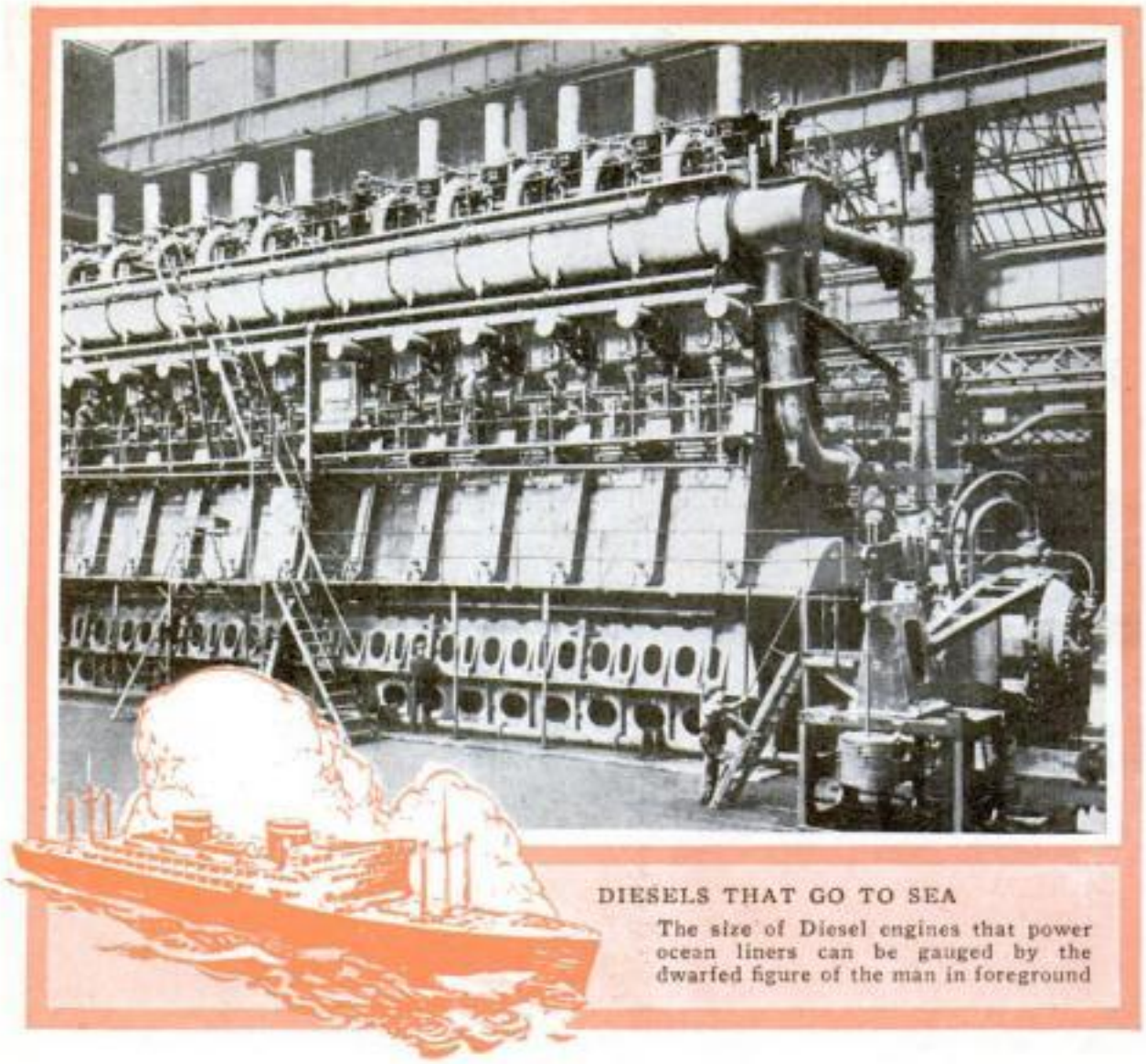
By another dramatic demonstration, the Diesel engine had given the world a glimpse of its possibilities.

For decades, trained engineers have predicted an age of Diesels. Now, these power plants are coming to the fore with a rush. Streamline "bullet trains" rush over the rails both here and abroad, powered by Diesels. Giant metal planes soar on European airways, their propellers spun by Diesels. And, in various parts of the world, busses and trucks ride highways with Diesel engines roaring under their hoods. Besides, these power plants are pulling batteries of plows, dragging immense logs, producing electric power, operat-



A DIESEL IN INDUSTRY

This big Diesel motor, being assembled in a Cleveland factory, will soon be playing an important role as an industrial power plant. It is a two-cycle, sixteen-cylinder motor built to deliver 1,200 horsepower. Charles F. Kettering directed its construction



DIESELS THAT GO TO SEA

The size of Diesel engines that power ocean liners can be gauged by the dwarfed figure of the man in foreground

ing canal locks, turning the wheels in thousands of factories.

In America alone, last year, the installations of these engines totaled more than 750,000 horsepower. This year, it is expected to pass the 1,250,000-horsepower mark. Virtually every large gasoline-engine manufacturer in the country is now entering the Diesel field. During the last twelve months, the advance in these engines has been an outstanding event in the world of power.

PHENOMENAL DEVELOPMENT OF INTERNAL-COMBUSTION POWER PLANTS USING HEAVY FUEL OIL PROMISES MORE ECONOMICAL OPERATION IN MANY FIELDS OF INDUSTRY AND TRANSPORT

Because they have no carburetors or ignition systems, they are simpler in construction than gasoline engines. Burning heavy fuel oil, with high temperatures required to ignite it, they are safer. Consuming less and cheaper fuel, they are more economical. And, in addition, they are more efficient.

Not long ago, an European manufacturer of Diesels set a world's record for engine efficiency. One of his marine motors, developing 5,500 horsepower, showed an efficiency of forty-one percent. Compare that with the steam turbine's twenty-five per cent, the gasoline engine's twenty, and the locomotive's six!

With all its advantages, why has the adoption of the Diesel been so slow? To find the answer, we must glance for a moment at the operation of this revolutionary motor.

If you have ever inflated a tire with a hand pump, you will recall that after a few minutes the pump became almost too hot to hold. Compressing air produces heat. This is the basis of the Diesel. The rising piston compresses the air within the cylinder to a pressure of from 500 to 1,200 pounds per square inch. This raises its temperature to 1,000 degrees Fahrenheit. At this point, vaporized fuel oil is sprayed into the superheated air. It ignites, just as the gasoline vapor does in an ordinary engine when the spark jumps between the points of the spark plug, and the volume of gases produced by combustion forces down the piston.

Because the pressures are infinitely greater within the cylinders, than in those of gasoline engines, Diesels have to be built with thicker, heavier walls. This is the first handicap. The weight of a Diesel is greater per horsepower than that of a gasoline engine. However, the use of heat-treated metals and new alloys is overcoming this disadvantage. The Cummins engine, for example, weighs only 15.6 pounds per horsepower, as compared with the weight of a similar-type gasoline motor, which ranges from ten to 14.9 pounds per horsepower.

A second disadvantage is the fact that Diesels are harder to start; greater effort is required to force the piston up to compress the air for the initial explosion. Balancing this is the fact that such an engine starts equally well in winter and in summer. Other defects—none of them insurmountable—are that the Diesel has less smoothness of operation and less flexibility than is possessed by gasoline engines. With a greater number of experts tackling these problems than ever before, overcoming such defects probably will be only a matter of time.

Behind this present activity lies a strange story of achievement—and of neglect. A Minnesota blacksmith, a German refrigeration expert, an American brewer, all played important parts in the drama of the Diesel.

About 1870, Christian Joergensen, a blacksmith in Minneapolis, turned out a curious predecessor of the modern oil-burning Diesels. Two blocks of hard wood at the top of the cylinder rubbed together to produce the heat for the initial explosion which would start the engine. After that, the heat from the compression of the air kept the motor firing.

In West Virginia, a few years later, a mine expert named Timothy Haverland was tinkering with a motor known as the "Coal Dust Producer." Instead of petroleum, it burned coal dust. For a number of years, it ran with more or less success. Then it exploded like a bomb, killing the inventor.

Coal dust was also the fuel used in the first engine tested by the man whose name is given to this type of power plant, Dr. Rudolf Diesel. Diesel was born in Paris, France, of German parents. He studied in technical schools in England and Germany and at one time was manager of a large Paris refrigerating plant. In 1893, he proposed his new type of engine, working everything out mathematically on paper before building a model. Three years later, his first full-sized Diesel demonstrated its possibilities. Then, like Haverland's coal-

Huge farm implements, such as this giant seed drill which seeds

dust engine, this pioneer of all the Diesels blew to pieces.

Luckily, Diesel escaped with his life. After he got out of the hospital, he turned to fuel oil in place of coal dust. When his next engine was running smoothly, an American brewer from St. Louis, Adolphus Busch, was in Germany on a visit. He heard of the revolutionary engine and visited Diesel in Augsburg. So impressed was he with the demonstration that he purchased American rights and introduced the engine into this country.

Although engineers grew enthusiastic over the possibilities of the engine, the financiers cannily waited for Diesel's patents to expire. In 1912, they did. The following year, the story of this German inventor came to a tragic end. Completely discouraged, he committed suicide by leaping from a ship crossing the English Channel.

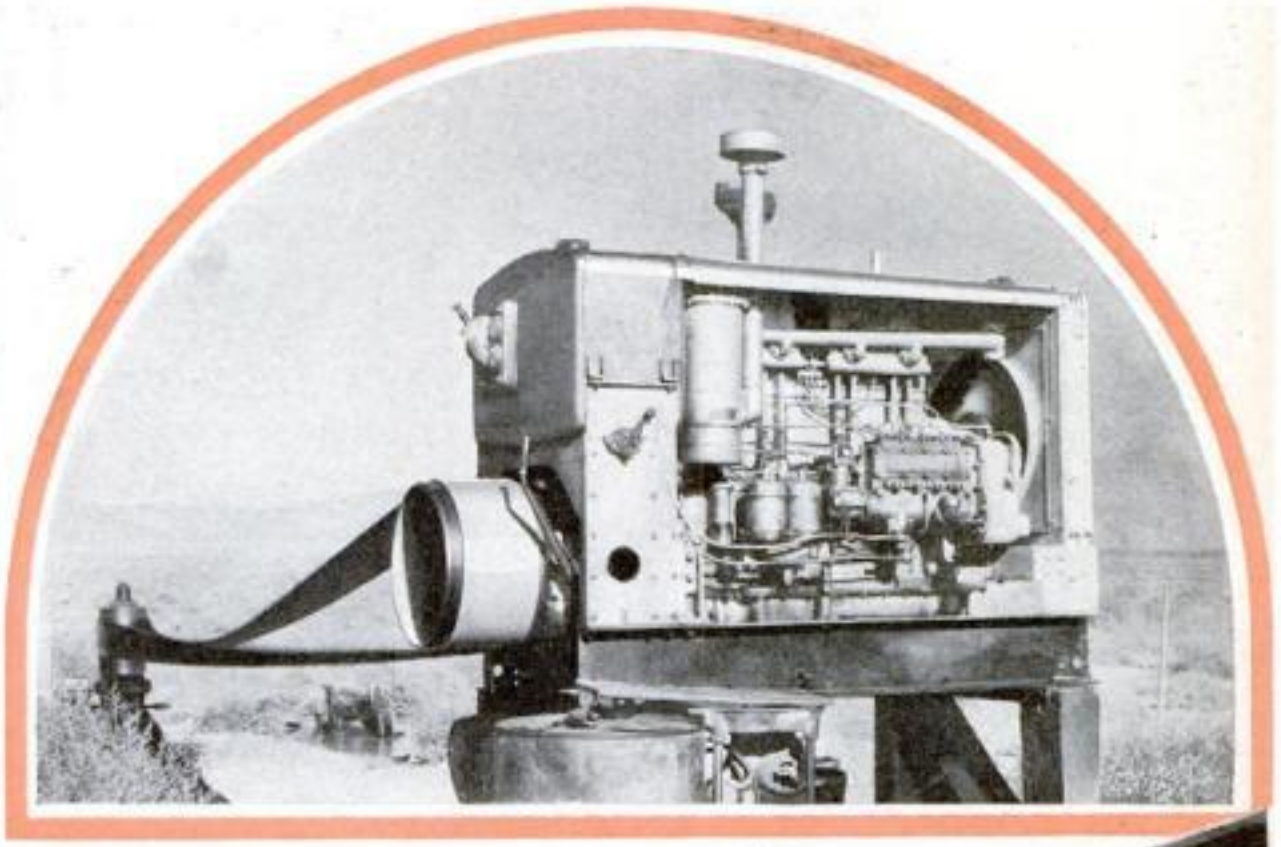
Eleven months later, the World War began and the first Diesel boom was on. Fighting nations turned to these oil-burning motors to propel their submarines along the surface and to perform a hundred other tasks. After hostilities ceased, progress was a long, slow climb, with the greatest advance occurring in the marine field. Now, with business conditions bringing economy to the fore, the use of Diesels has zoomed to new records.

How economical the engines are is revealed on the cost sheets of many concerns. Consider a few instances in the realm of transportation.

On the Pacific coast, when Diesel motors were installed in four highway express trucks, they clipped $2,000 from the fuel bills in a single month. On another line, a truck and trailer carried a thirteen-ton pay load on a round trip between Spokane, Wash., and Portland, Ore., on eighty-seven gallons of fuel oil. Other trucks on the same run consumed 210 gallons of gasoline. The average price of gasoline in the United States is about nineteen cents a gallon; that of fuel oil, six.

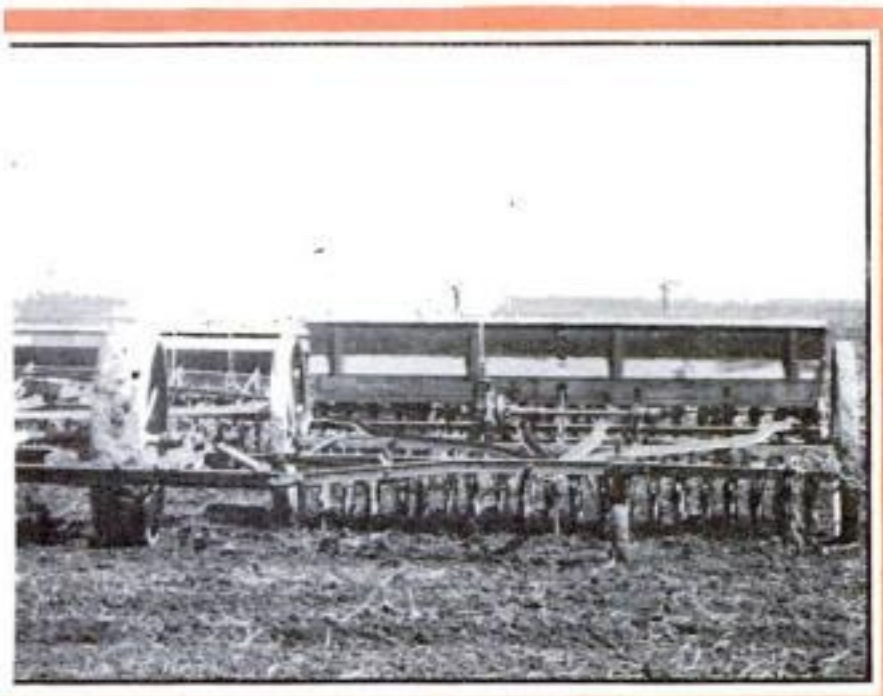
One organization which operates twenty-one Diesel-powered trucks, and has ordered fifty more, saves approximately fifty dollars in fuel on every trip between Los Angeles and Fresno, Calif. In ten months, a Diesel bus covered 130.000 miles—equal to more than five circuits of the globe—and averaged nearly ten miles to the gallon of fuel while making speeds up to sixty miles an hour. Another bus, linking Pittsburgh and Philadelphia, Pa., covered 5,232 miles in its first two weeks. It was on time at the end of every run, and it averaged eight miles to the gallon of fuel oil as compared with four and a half miles to the gallon of gasoline for the other coaches of the line.

The result? One American concern, which had barely 100 installations of its Diesel truck and bus engines in January, 1934, had 1,000 by November of the same year! Another builder who turned out 1,056 horsepower in Diesel engines in 1931, reached 237,314 horsepower last year. Trucks powered by one make of American Diesels are averaging 4,000,000 miles a month. In 1931, there were only twenty-five Diesel busses in all of England. Today, there are 5,500, and ninety percent of the heavy-duty trucks carry Diesel engines. During the twelve months of last year, the Diesels of one European manufacturer alone burned 25,000,000 gallons of fuel.



On an irrigation project, a Diesel unit drives the pump

Large transport airplanes powered with Diesel motors, similar to this German Junkers type, are now making their appearance. This German ship, with four 750-horsepower motors, cruises at a speed of 135 miles an hour



fifteen acres an hour, are hauled by Diesel-driven tractors

Not long ago, a French motor-car builder announced a ten-horsepower Diesel runabout. Tests are said to have shown that fuel consumption is so low you can drive ten miles for a cent!

In considering the question of economy, the important thing is the fact that a Diesel uses less fuel as well as cheaper fuel. When this type of power plant is widely adopted, the price of fuel oil undoubtedly will rise and added taxes may make it as expensive as gasoline. Even so, the inherent efficiency and economy of the Diesel will make it cheaper to run.

An American pioneer in automotive Diesels is C. L. Cummins, a mechanic and inventor of Columbus, Ind. His patented metering device, which injects carefully measured amounts of fuel oil into the cylinders, gives smoother performance to engines he has installed in trucks, busses, boats, and automobiles.

In 1931, a racing car powered by one of his motors completed the 500-mile grind at the Indianapolis Speedway without a stop. Using only thirty-one gallons of fuel, it placed thirteenth. Last year, another Cummins racer, with "Stubby" Stubblefield at the wheel, crossed the line in twelfth place after another non-stop race. *(Continued on page 108)*

Guarding Our Shores

A Never-Ending War Fought With

When rodent plagues rage in foreign ports, suspected ships are sealed and fumigated to rid them of disease bearers

In the ship, masked men release a deadly gas. Here a mechanical cutter is being used to open a "cyanide can"

By
STERLING
GLEASON

TERROR swept across the highlands of Mexico, late in 1934, as a creeping blindness struck inhabitants of thirty-five villages in the state of Oaxaca. Back of the mysterious epidemic lay a strange history.

Borne by sultry tropic breezes, a slave trader sailed into the West Indies one day two centuries ago bearing a pitiable cargo—scores of African negroes destined for the slave markets of the New World. Among them were blacks whose heads and bodies, covered with festering sores, gave hideous proof that their blood streams had become infected with threadlike, microscopic parasites from African forests.

In the steaming jungles of Guatemala, swamp gnats, attacking the newly arrived, infected negroes, picked up these parasites and spread them broadcast among the gnat hordes of Central America. Ever northward crept the smoldering fires of disease until finally, in midsummer of 1934, swarms of the tiny, parasite-laden gnats invaded Mexico. They carried out their deadly attack so swiftly that a thousand new victims fell before a vigorous counterattack by the Mexican National Health Department began to bear fruit.

Meanwhile, a thousand miles to the north, vigilant medical sentries watched the course of the dreaded malady. Would it continue to march northward, overrunning North America as it already had spread through Guatemala and Mexico? Research workers of the University of California knew that high up in the mountain streams of western United States were billions of Simulium flies, every one a potential carrier of the parasite. A single infected gnat might prove the spark that would kindle the fires of disease over half a continent.

Today fast transportation—airplanes, automobiles, and fast steamships—brings the United States in ever closer contact with the life of the tropics. Down through the years, trade has left a ghastly trail of disease in its wake. With the African slave traffic came malaria and many other maladies. Yellow fever raged through southern cities for years after it had been imported, along with mahogany and rum, from the West Indies. Travelers from Canada brought germs which resulted in our last two severe epidemics of cholera.

Trade with Europe and Africa introduced leprosy, which was not uncommon in the Mississippi valley 150 years ago. Even today, Louisiana has a Federal leper colony. A century ago, European emigrants brought relapsing fever, now firmly entrenched among infected ticks in Texas and California where these insects form a constant source of human infection.

Guarding our nation against this menacing tide of tropical disease is a never-sleeping watch maintained by the U. S. Public Health Service and by workers of a few great universities. Recently, I visited the chief outposts along our western frontier to see how science is aiding in the war against alien diseases.

This mouse, infected with the germs of a little-known tropical disease, is a laboratory subject. His role is to aid in the fight against epidemics

The U. S. quarantine station on Angel Island in San Francisco Harbor, an outpost of the Public Health Service. Arrivals from quarantined ports are held here for observation

Against Jungle Diseases

Test Tubes and Microscopes

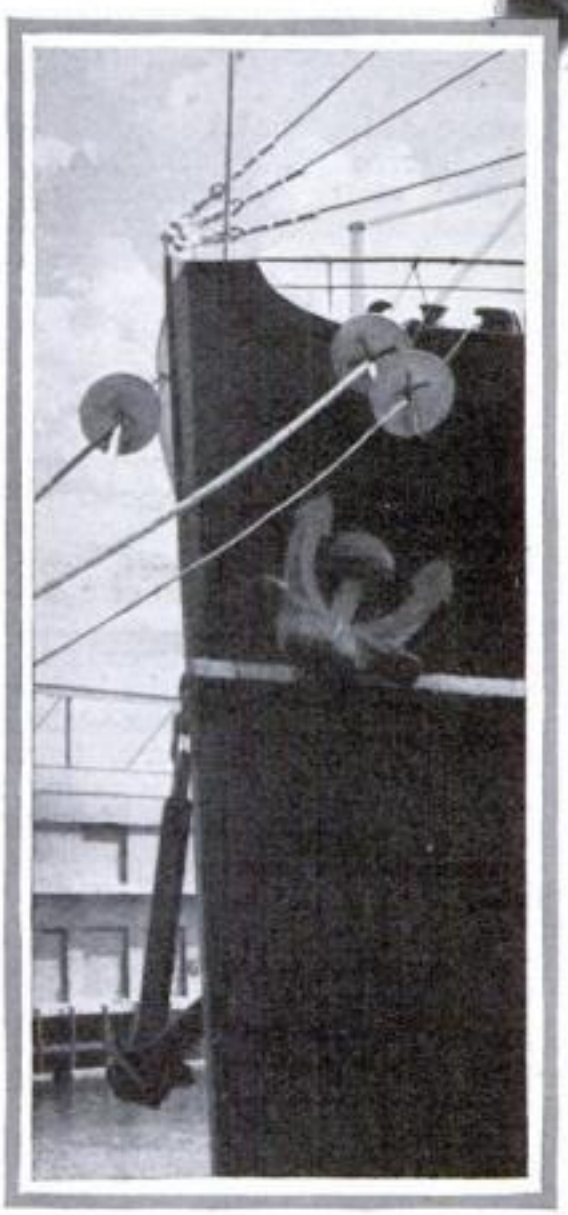
PARASITE HOST

Securely held in the forceps is a "kissing bug." This insect is a carrier of the parasite causing Chagas disease, for which there is no known cure

Aboard a smoothly running government tug, I visited Angel Island, in San Francisco Bay. At this typical post, I saw how Uncle Sam's medical army, with test tube and microscope, polices our borders against invading germs. At one time this island medical fortress held in quarantine 4,000 people, just arrived from a port where an epidemic of cerebrospinal meningitis was raging. They were quarantined fourteen days to permit any incipient cases to develop, after which the passengers were released as fast as bacteriological tests cleared them.

Later, I stood on the deck of a boarding cutter as it sped out of the quarantine station in Los Angeles harbor, to meet a Japanese oil tanker just back from a record-making trip to the Orient. As we came alongside, a crew of inspectors stepped across and ascended the accomodation ladder to the tanker's deck. Public Health Service doctors questioned the master of the vessel and the ship's surgeon as to whether there had been any sickness during the voyage.

Research workers prepare and mount specimens of tropical parasites for microscopic examination



The metal disks on the ship's hawsers are typical of the shields that are placed on all mooring lines to block the passage of rats

They studied the ship's bill of health, which must contain the following information: kind of cargo, ports touched, and health conditions in each city and the surrounding back-country. Also, there must be listed definite data as to the last known cases of any of nine deadly diseases mentioned by the National Quarantine Act: bubonic plague, Asiatic cholera, yellow fever, typhus, leprosy, smallpox, anthrax, cerebrospinal meningitis, and psittacosis. The crew was then mustered and given a searching medical examination.

Meanwhile, an agricultural inspector searched for signs of plant parasites on the freight to be discharged. A representative of the Bureau of Animal Industries inquired concerning live stock which might spread disease to our animal population. Because diseases of domestic and wild animals often spread to human beings, this inspection is important from a medical standpoint, although sometimes it introduces queer situations.

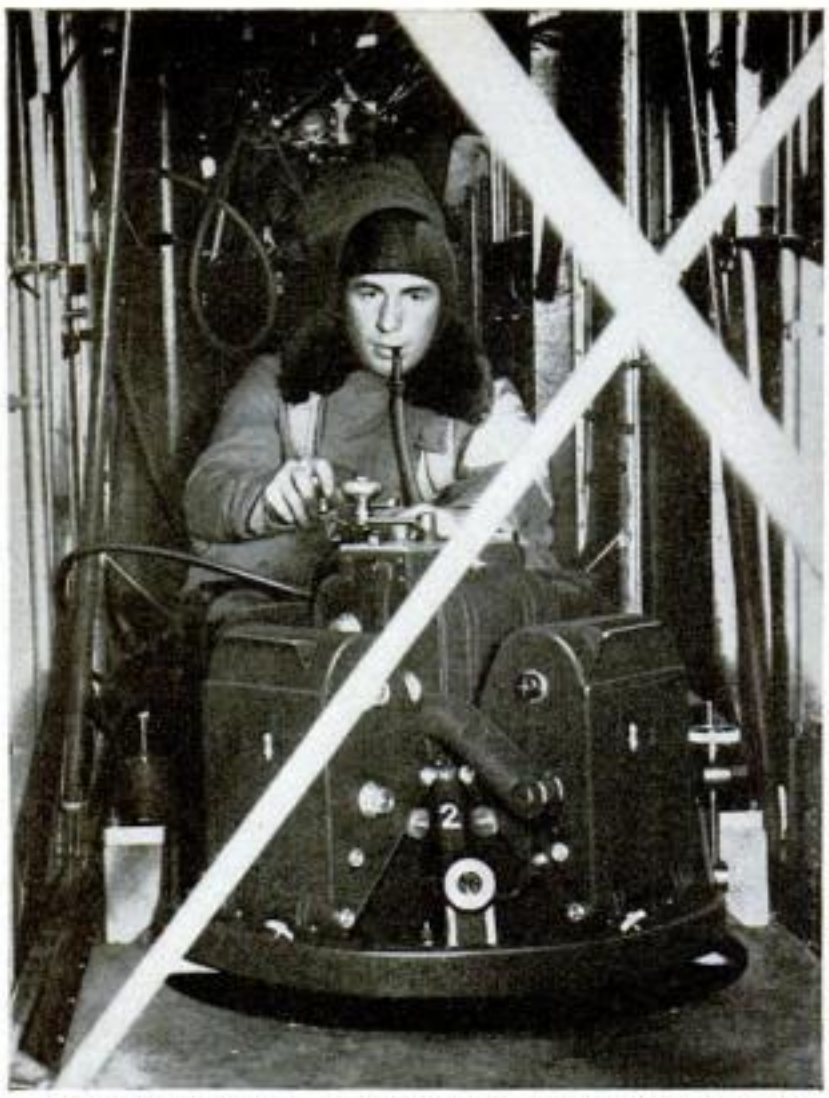
Such a case recently threatened international complications when one of the great Royal Netherlands mail fleet made its first call at one of our Pacific ports. Aboard the liner, direct from the Dutch East Indies, were three sacred cows carried to satisfy the religious rites of her Javanese crew. Threatened with a lengthy quarantine, a protest by the ship's captain to his government was averted only when a mistake had been discovered in the ship's papers which had made it appear that the cattle were from a port where epidemic disease was prevalent.

No animals were aboard our Japanese tanker, however, and the inspection was soon finished. Down from the mast came the yellow flag, signifying that quarantine was over and that the ship, with a clean bill of health, might proceed to discharge her cargo.

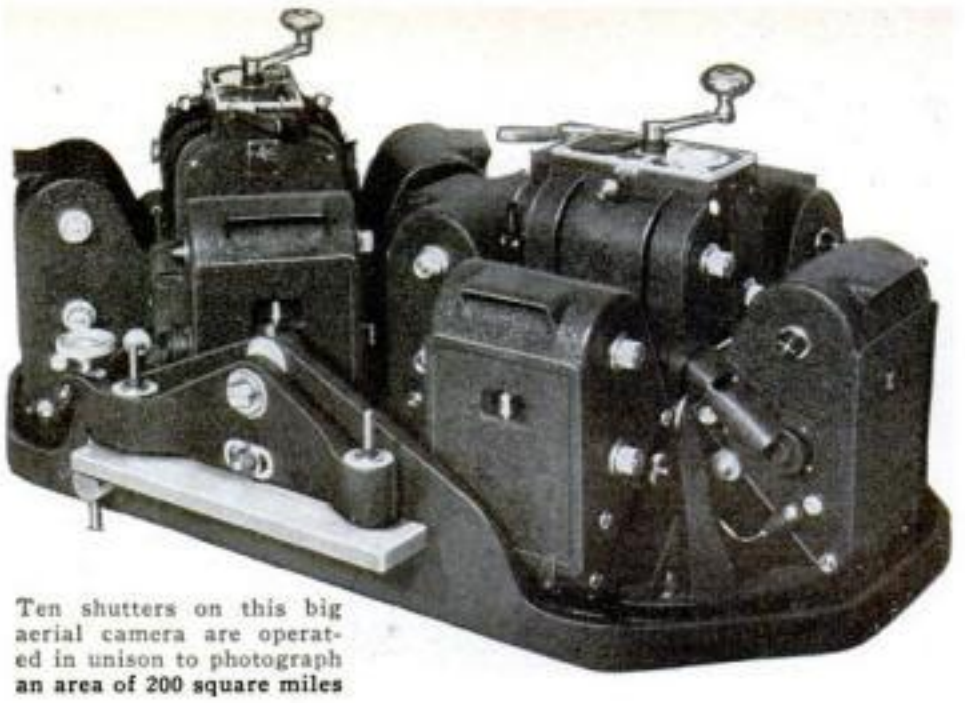
From all parts of the world, a network of confidential-information channels converges upon the Public Health Service headquarters at Washington, where the changing picture of world disease is constantly watched by experts. From American consuls in major ports of the world, from authorities of foreign countries, by mail, wire, and radio, flow reports on health conditions. If cholera rages in Bombay, a warning speeds to Washington and is relayed to all inspectors, who doubly scrutinize all vessels that have touched at any of the Indian ports.

Not long ago, a boat arrived at San Francisco from the Orient and underwent inspection in the regular way. Probably not one of the passengers noticed anything unusual in his examination. Yet, at Honolulu a man had been taken off the boat, sick with smallpox, and that information, radioed ahead, put government inspectors on the alert for symptoms of the disease.

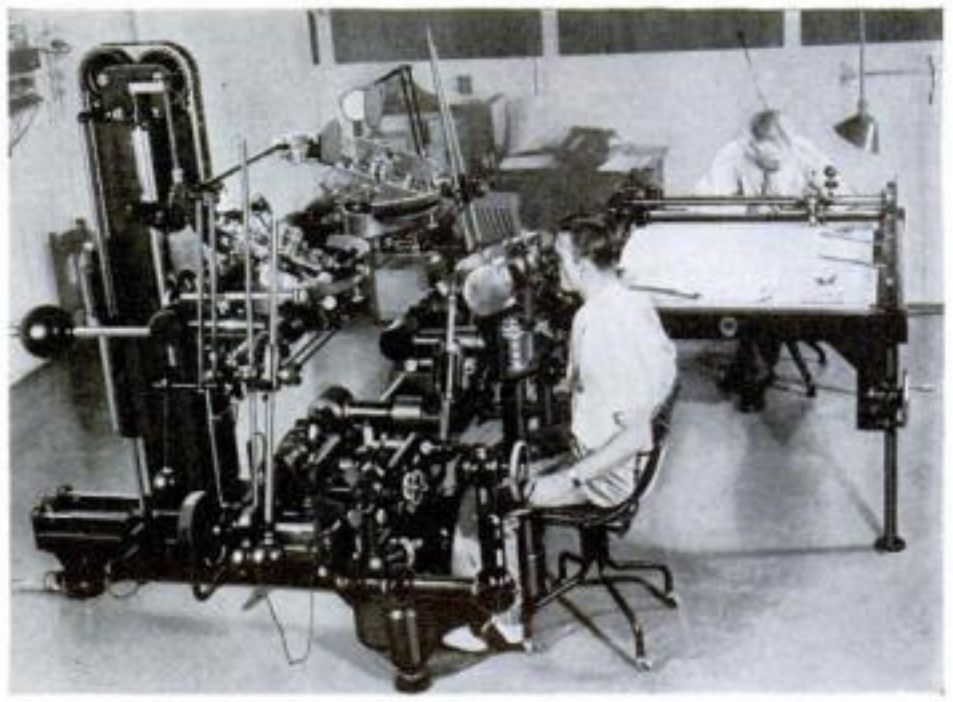
As the government tug left the tanker's side and headed back to the quarantine station, I heard *(Continued on page 116)*



Camera installed in a plane for use four miles above the earth



Ten shutters on this big aerial camera are operated in unison to photograph **an area of 200 square miles**



Right, using a huge stereoscope for plotting contours from aerial photographs

TEN-EYED AERIAL-SURVEY CAMERA PHOTOGRAPHS 200 SQUARE MILES

SPECIALLY designed for use in a soil-erosion survey of the Rio Grande Valley in central New Mexico, a new-type aerial camera has ten lenses and ten shutters and will be used by an oxygen-breathing photographer at a height of more than four miles above the earth. Largest in the world, the compound ten-lens instrument snaps an area of more than 200 square miles every time its shutter control is tripped. Electricity operates the ten individual shutters in unison, and a neon light flashes to warn the operator if any one of them fails to function properly. The composite print made by the giant camera measures nearly a yard square. When planes using this and other cameras have mapped the 35,000 square miles of arable land included in the survey—an area about as large as the whole state of Indiana—the pictures will be assembled in a giant mosaic map. Contours showing elevations and slopes will be plotted by placing successively exposed pictures, two at a time, in a complicated machine that is, in principle, simply a huge counterpart of the old-fashioned parlor stereoscope, and similarly gives the effect of relief. From a study of the individual slopes of the rugged terrain, Federal agencies will determine what methods of farming and what engineering works will be most effective in combating erosion.

HOME OUTFIT FURNISHES SHOP FOR SHEET-METAL WORKING

Home metal-working outfit in use. It supplies all tools and accessories needed for this hobby

WORKING sheet metal, as a hobby, is made easy by the introduction of a complete home outfit for amateur craftsmen. With its aid, a home-workshop enthusiast may construct a host of articles both of decorative and utilitarian value—tables, smoking stands, waste baskets, flower stands, fire screens, bath-room cabinets, and a variety of other pieces limited only by the ingenuity of the designer. Ordinary house current operates the small electric spot welder that is one of the features of the metal-working outfit; another is a metal jig shear with which intricate interior or exterior designs may be rapidly cut in metal. The shear is also capable of straight slitting at a speed of twelve to fifteen feet a minute. All necessary accessories are provided for bending, forming, punching, and cutting flat stock one-twentieth of an inch thick or lighter. A portable paint-spraying outfit and spray booth, for applying the finishing touches to the hobbyist's creations, complete the equipment.

MOTORS AND MAGNETS TO RUN HUGE TERRESTRIAL GLOBE

A GIANT mechanical globe being built for the world exposition at Paris in 1937 will depict the earth's continents and seas on an exact one-to-1,000,000 scale. Tiny ocean vessels, operated electromagnetically, will ply the principal trade routes. By pressing buttons, the world's famous volcanoes will be set in action. Encircled by a spiral ramp for onlookers, the forty-three-foot globe will turn realistically on its axis, and will be lighted by an artificial sun and moon.

Prof. E. Ratzer, designer of the giant globe, at work on a relief model of a part of its surface. At the right is shown how the globe, surrounded by a spiral ramp, will appear at the world exposition at Paris

MICROPHONE GETS SOUND FROM ANY DIRECTION

RESEMBLING an apple impaled on a stick, the latest type of microphone to be introduced for use in radio broadcasting and sound recording is said to be equally responsive to sound from any direction, allowing performers considerable freedom of movement and grouping. Despite its unusual compactness, the new "mike" transmits a wide range of frequencies without distortion, and improved electrical characteristics permit it to be used several hundred feet away from its amplifier.

ELECTRIC EYES GAUGE SPEED OF CAR

HOW FAST a motorist is traveling is instantly determined by a "speed meter" perfected at Massachusetts State College. Electric eyes record the time a car takes to cover the eighteen-inch distance between two parallel light beams directed across a road, giving a reading directly in miles per hour. A use for the new meter is foreseen in studies of motorists' driving habits.

HOUSE IS MOVED TO MAKE ROOM TO REPAIR IT

Footing created for workmen by moving house

BECAUSE her house abutted upon a neighbor's property, and the neighbor refused permission for ladders to be set up on her lawn, a Chicago home owner recently found herself in a quandary when the north wall of her residence needed repairs. She solved her problem by having the whole house moved thirty inches to one side, giving the workmen a footing, as shown above. At the completion of the job, she planned to have the house moved back again to its original position.

SPARE WHEEL SWINGS CAR INTO PARKING SPACE

A MOBILE spare wheel, devised by a Hartford, Conn., inventor, aids in parking in a cramped space. When the driver has nosed his car as near the curb as possible, he sets in motion a mechanism that drops the extra wheel into contact with the ground. Power from the engine then raises the rear end of the car from the pavement and rolls it sideward, by turning the fifth wheel, to the curb. The procedure is reversed in leaving the parking space. All operations are controlled by the driver without leaving his seat. The photograph at right shows the inventor pointing out the mechanism that lowers the wheel and transmits power to it.

GIANT BURNING GLASS HARNESSES SOLAR HEAT TO RUN FURNACE

Perched like a spider on the frame of the composite lens, a workman polishes the prisms of the solar furnace. Right, the tower on which the lens turns

The inventor at the smelter box located at the focus of the lens. The heat is said to melt metals

A BURNING GLASS nearly ten feet in diameter has been constructed by an inventor of Madrid, Spain, to test the possibility of harnessing solar heat for industrial purposes. Glass prisms, arranged concentrically in a spider-web frame, form a composite lens, and concentrate the sun's rays in a smelter box at its focus. Temperatures high enough to melt glass and metals are reported to be obtained, and blocks of wood dropped into the box instantly burst into flame, while a steak held over the opening is thoroughly grilled in ten seconds. A motor turns the apparatus automatically to follow the course of the sun. Every morning, a workman polishes the prisms to insure maximum efficiency. The designer proposes to erect a battery of twenty solar furnaces, each one many times the size of the present installation, and to use their combined power to run factory machinery.

Free power from the sun has been the goal of many inventors (P. S. M., Oct., '34, p. 32), but large-scale attempts to harness solar power, thus far, have mainly been disappointing, However, the idea has proved entirely practicable for certain restricted purposes. Dr. Charles Greeley Abbot, of the Smithsonian Institution, has built a "solar cooker" that prepares meals for an entire household. A still more novel application of sun power, for making ice, is described on page 30 of this issue.

HELICOPTER MAKES 100-MILE SPEED

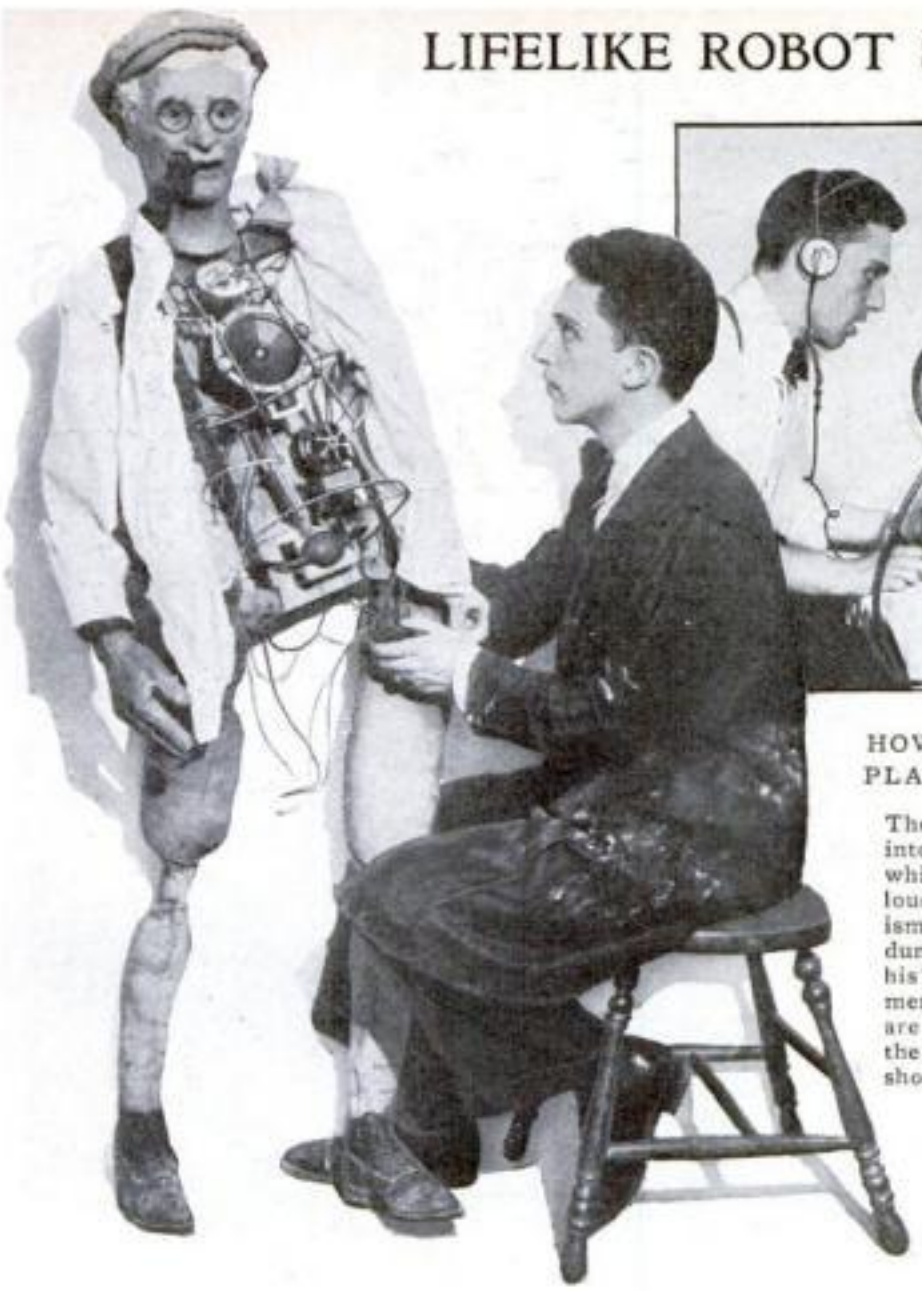
FIRST TRIALS of a helicopter of new design, at an airport near Paris, France, are reported to have shown it capable of a speed of 100 miles an hour. Named the "giroplane," the queer craft is the creation of Louis Breguet, noted French airplane builder, and represents the latest attempt to produce a machine capable of rising straight up or of hovering motionless in the air. The picture shows it in flight.

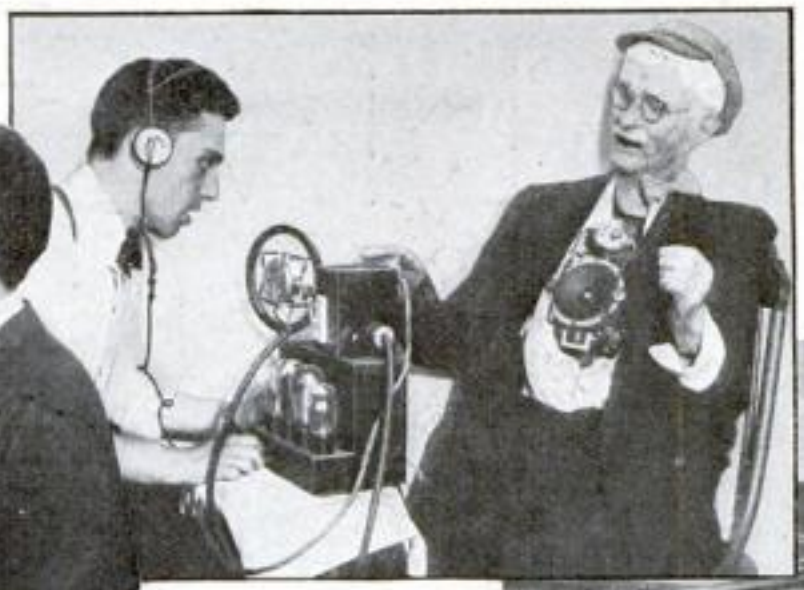
Images of bombing airplanes are thrown on a table map in this camera obscura

CAMERA OBSCURA SPOTS BOMBING AIRPLANES

A TURRET-SHAPED camera obscura has been installed at Hamilton Field, Calif., to follow the maneuvers of bombing planes. A wide-angle lens in its top projects images of aircraft upon a table map, enabling an observer within the chamber to check their position with accuracy.

LIFELIKE ROBOT SPEAKS, SMOKES, AND DRINKS





The robot and a companion go fishing. So realistic in appearance is this mechanical man that it is hard to pick him out at a casual glance. After closer inspection, you may distinguish him as the figure sitting on the right

HOW THE DUMMY PLAYS ITS PART

The operator talks into a microphone which actuates the loudspeaker mechanism (exposed) in the dummy and gives him his 'voice'. The movements of the robot are made possible by the intricate works shown at the left

SINGING, smoking, drinking, and holding an animated conversation are some of the accomplishments of an amazing mechanical man designed by Milton Tenenbaum, of Brooklyn, N. Y. Controlled remotely from a concealed point of vantage, the robot is operated by built-in electric motors. A rubber bulb, alternately squeezed and released by a motor-driven cam, enables the automaton to puff a lighted pipe realistically. Compressed air stiffens or relaxes its legs. Words addressed to the robot, picked up by its hidden microphone, are carried to the distant operator, who replies through a loudspeaker in the dummy figure. Meanwhile the lips of the figure move in a lifelike fashion. The creator of the mechanical man, a young sculptor, proposes the use of figures of this type in animated movie cartoons.

BICYCLE HAS STEERING LOCK

A LOCK permanently built into a bicycle of new design securely clamps the steering post to guard the machine against theft. Patterned after types used in automobiles, the lock is of five-tumbler design and is declared to be proof against picking or tampering. Its use dispenses with the makeshift padlock and chain, often used by cyclists.

BULLET-FIRING AX DISPATCHES GAME

AN AX that fires a bullet has been designed for hunters and campers. Opposite the six-inch blade is a chamber that may be loaded with a 32-20 calibre cartridge, which is normally held away from a stationary firing pin by a coil spring. A blow with the ax on the head of a wounded deer or bear produces enough concussion to set off the load, dispatching the animal instantly. There can be no misses. In the test illustrated, a hole was blown in a barrel top.

DUMMY CAT SERVES AS SCARECROW IN GARDEN

A SCARECROW in new guise protects the garden of a Connecticut home owner against birds. Perched on a near-by tree trunk, an imitation cat keeps a watchful eye and is said to frighten feathered visitors away from freshly planted seeds.

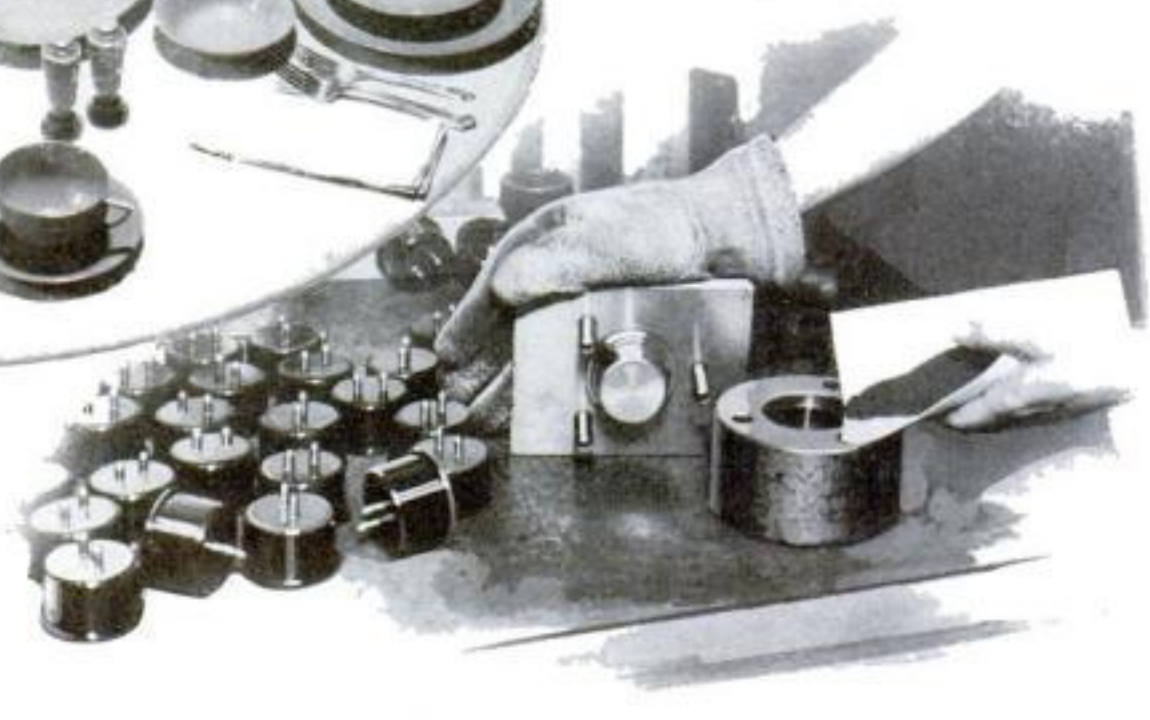
MINT AIDS DIGESTION

TAKING mint candy or peppermint cordials after a heavy meal is a custom vindicated by modern science. Tests recently reported to the American Medical Association show that oil of peppermint, which these contain, speeds up digestion and helps avoid the feeling of a distended stomach, particularly after a meal with a high content of fats.

CHEMISTRY GIVES US

Amazing New Substances

FOR ART AND INDUSTRY



Lamp bases of plastic material and the mold in which they are cast. Note the molding powder being poured into the mold. In oval, tableware made of colorful plastics

At top, small insulating parts for radios being die-punched from sheets of laminated plastic. Above, cutting gear blanks to shape on a band saw. At right, a finished gear cut from a block of laminated plastic

WHEN you look at the face of your watch, switch on the radio, press the starter button of your car, or unscrew the cap of your fountain pen, the chances are you make use of plastics—the marvelous synthetic materials that, in the last few years, have become vital to hundreds of industries.

Telephones, radios, chairs, dishes, buttons—all sort of useful articles, from steering wheels to surgeons' masks, from safety glass to fishing reels, from false teeth to bird cages, now are made, wholly or in part, of plastics. The magic of modern chemistry has produced these materials which are unlike any natural substances found on earth or in the sea.

Some plastics are formed of synthetic resins, others have bases of casein, nitrocellulose, or cellulose acetate. In use, some plastics are molded, some cast, some laminated. They vary in characteristics as well as in origin. Some are affected by heat and acids, others are resistant to both.

Curiously enough, it was the game of billiards that started, some sixty years ago, the movement toward the wonders of modern plastics.

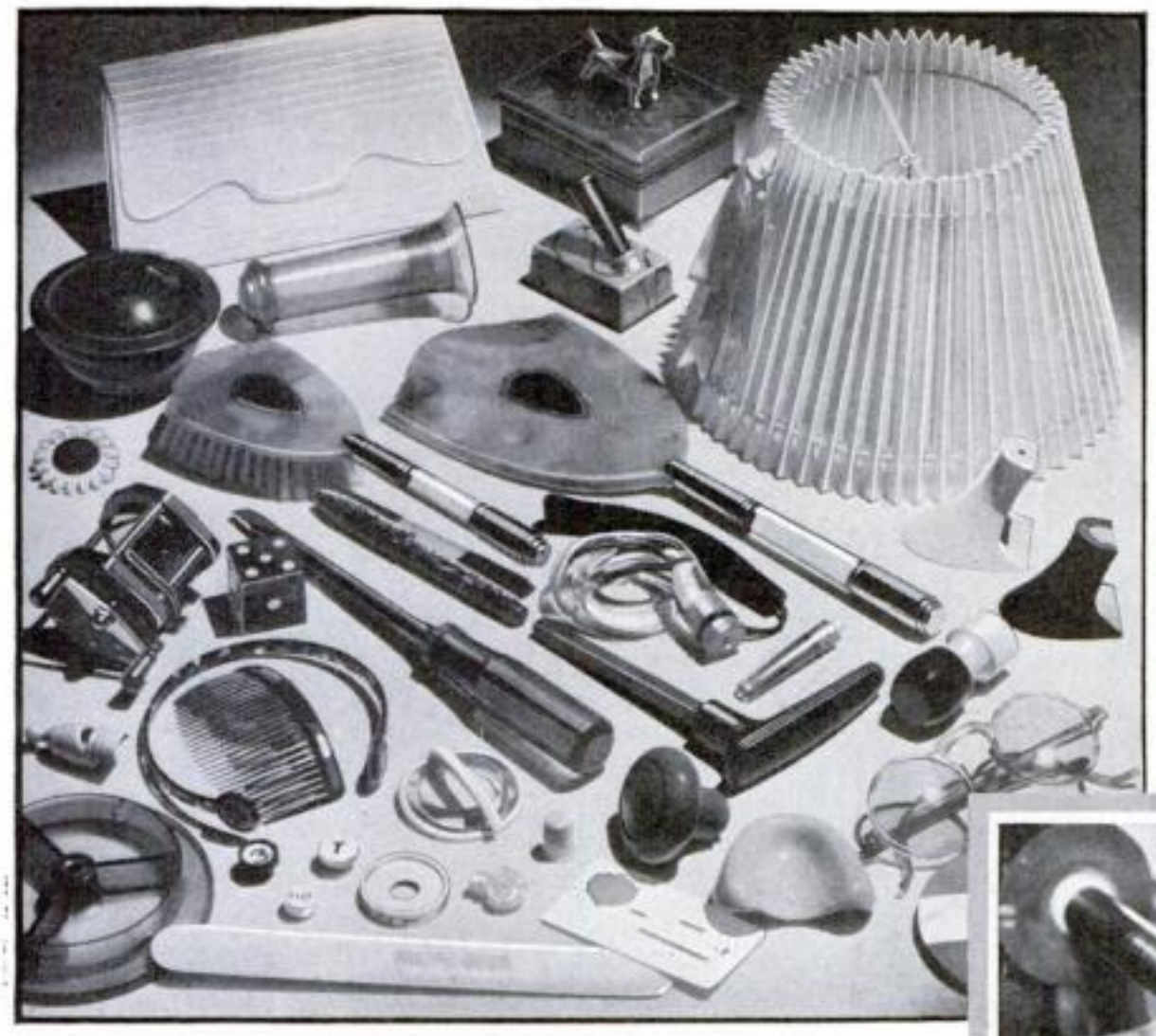
About 1870, a manufacturer of billiard equipment in New York City offered a prize of $10,000 for a substitute material that could be used in place of ivory in the balls. John Wesley Hyatt, a printer from the village of Starkey, N. Y., was one of the contestants. Night after night, he fussed in his makeshift laboratory, mixing chemicals, heating liquids, applying pressures. Finally, he hit upon a new substance. It was celluloid, the first of the plastics.

Today, celluloid has 25,000 uses and there are more than 300 other creations of the test tube in the plastics field. Their trade names add curious words to the modern vocabulary: Bakelite, Pyralin, Tenite, Ameroid, Beetleware, Plaskon, Durez, Catalin, Durite, Micarta. So important are these products that the Smithsonian Institution, at Washington, D. C., recently added an exhibit to show their creation and uses.

Some forty years after the printer, Hyatt, discovered celluloid, snapshot enthusiasts all over the country contributed indirectly to the next great step in plastics.

A Belgian-American chemist, Dr. Leo Baekeland, had produced a superior printing paper for photographers. With money obtained from its sale, he financed extensive researches in a private laboratory at Yonkers, N. Y. Over and over again, he tried an experiment which had always ended in failure. He was seeking to combine carbolic acid and formaldehyde.

In 1907, a catalyzer—a chemical agent



A few of the 25,000 articles in which thermoplastic materials are employed

Carving a bracelet from synthetic resin with a high-speed cutting machine. Below, an umbrella head made from one of the many cast resinous plastics

Photographs Courtesy of "MODERN PLASTICS"

Synthetic Materials, Unlike Any Found in Nature, Are Created in the Laboratory To Meet Demands of Beauty and Utility

By John E. Lodge

which causes other substances to react without entering the combination itself—enabled him to succeed. The material produced by the reaction was entirely new, hard, clear, yellow. In appearance it suggested amber, but its characteristics were quite different. In honor of its maker, the new substance was named Bakelite.

Experiments with Bakelite revealed a curious fact. In its raw state, heat softened it and alcohol dissolved it. But, when it was subjected to great heat, it hardened into a state in which neither chemicals nor heat affected it. Some other plastics have a similar characteristic. It marks the dividing line between the two groups, the thermoplastics and the thermo-setting plastics. The first group is affected by heat; the second is not.

In the first group, you have the plastics with a nitrocellulose base, a cellulose-acetate base, or a casein or a vinyl-resin base. In the second, you find the laminated plastics, and the urea and the phenol-formaldehyde resins. Celluloid is a representative of the first group; Bakelite of the second.

From these two groups come a thousand and one products to meet the needs of modern civilization.

Plastic substances now give us salt and pepper shakers, piano keys, birthday cards, animated cartoons, umbrella handles, scuffless heels, crow calls, imitation gold fish, tooth brushes, combs, magicians' apparatus, fishing bait, gavels, hotel-room numbers, table-tennis balls, sword handles, thimbles, and shoe-lace tips. Slide fasteners made of plastics instead of metal are now on the market. One of the queerest uses of plastics is in the manufacture of two-foot-long shoe horns designed to aid men who are too fat to bend over and put on their shoes!

Recently, the cast resins, which come in brilliant colors and mottled effects, have attracted wide attention. They are sold in rods, tubes, and sheets, and are employed extensively in the production of jewelry and art objects. Home-workshop enthusiasts have discovered that such materials can be worked almost as easily as wood. From them, they are producing book ends, lamp bases, drawer handles, and dresser sets. Special kits, suited to the needs of amateur craftsmen, are now on the market.

Skilled artists have made use of the new materials to produce delicately tinted carvings. Effects impossible to achieve in wood are attained with the cast resin. Among its industrial products are chessmen, pipe stems, knife handles, bowling pins, and a host of ornamental objects.

It is estimated that three out of every ten automobiles carry plastic materials in their gear-shift knobs, radiator-cap ornaments, or cigarette lighters; that five out of every ten handles for picnic knives are made of the brilliant substances, and that seven out of every ten pieces of costume jewelry are formed of the same material.

In some instances, holes are drilled into the pieces of cast resin and dye injected to produce a striking coral effect. Factories which have batteries of valve wheels, side by side, are preventing mistakes by making the wheels of plastics, each in a distinguishing color. One of the latest products in this field is wood impregnated or coated with a synthetic resin.

Before they are treated with aniline dyes, cast plastics are transparent. Undyed, they are finding an expanding field of uses, forming shatterproof crystals for watches and replacing glass in other articles. When a new restaurant opened its doors in New York City, not long ago, its most striking display was formed by neon tubes glowing within bars and sheets of tinted synthetic resin.

Behind the success of this rainbow-tinted material lies a World War quest for synthetic rubber. During the last weeks of hostilities, the rubber shortage in Germany became acute. Chemists worked at fever heat to find a laboratory substitute. They failed. But out of some of the experiments there developed the basic material from which the cast resins are produced.

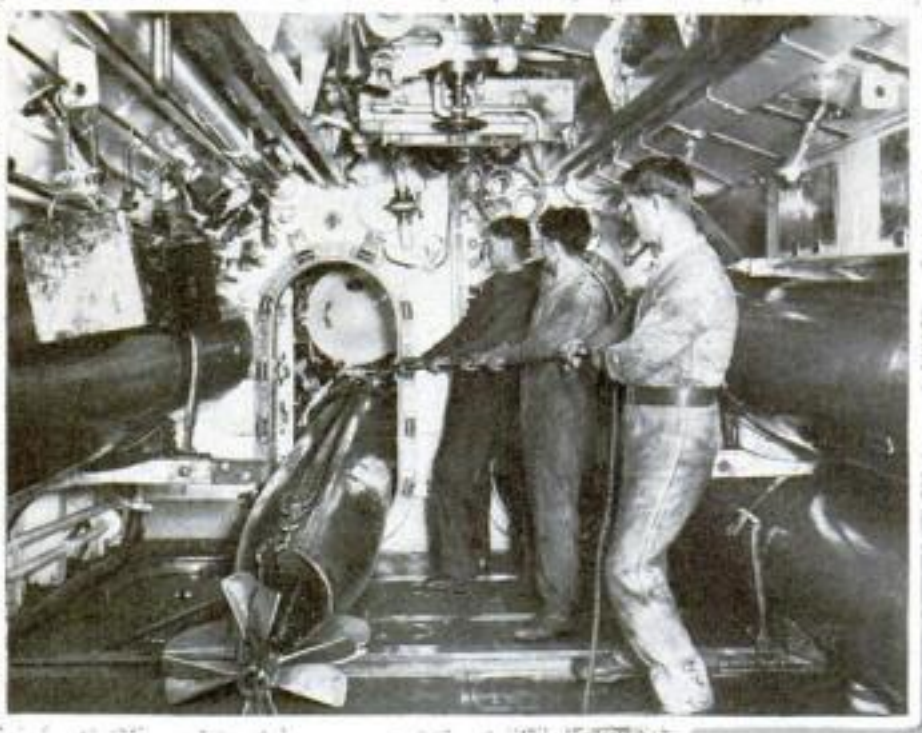
Although these belong to the thermoplastic group, they are able to withstand dry heat up to 275 or 300 degrees F. This makes it possible to use them for ash trays, cigarette lighters, and lamp fixtures. Also, they are resistant to acids. Created in the laboratory, these materials are now going back to the laboratory in the form of superior beakers, flasks, and vials.

The cast plastics consist entirely of synthetic resins. The molded plastics, however, such as Bakelite, are mixed with fillers, such as pulverized wood, asbestos, or mica, and placed in machines under tremendous temperatures and pressures until they flow and fill the molds. Because the temperatures destroy the aniline dyes, these plastics appear only in a few shades, generally black. But in this color they are known in all parts of the civilized world.

They fly with airliners, plunge into the ocean in submarines, ride the sea as fireproof fixtures on ships, appear in a thousand and one *(Continued on page 111)*

Undersea Battleships...

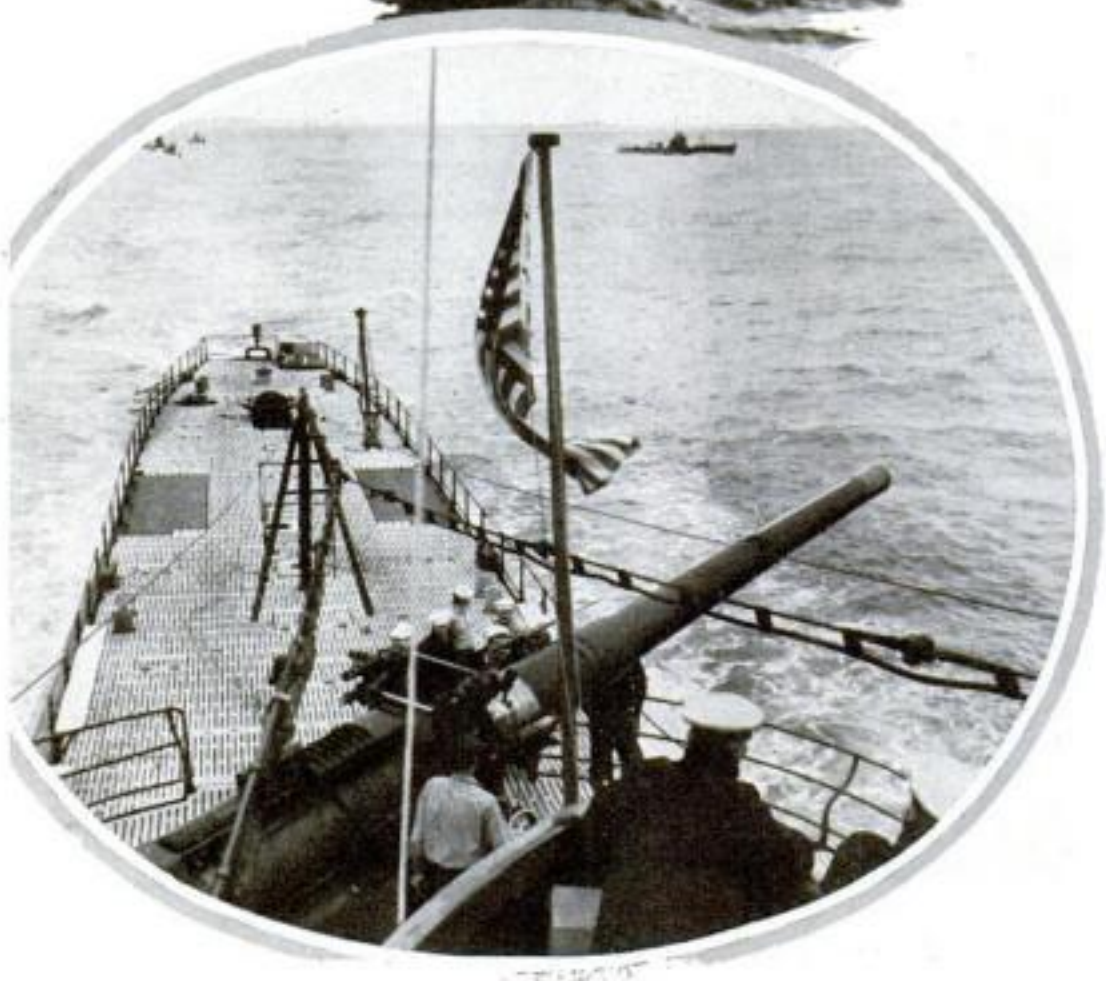
POWERFUL NEW SUBMARINES JOIN WORLD NAVIES



The submarine's most deadly weapon. This picture shows members of the crew of the *L-56* placing a torpedo in one of the tubes. The torpedo itself is a machine of amazing precision and represents an outlay of about $10,000. Its propellers, driven by compressed air, thrust the projectile through the water as it hurls its deadly charge of high explosives against the hull of an enemy vessel

An officer closing the conning-tower hatch of the British submarine *L-56* preparatory to submerging the vessel. Relatively small as compared with some of the latest undersea monsters, this 235-foot craft is of 845 tons surface displacement

The *Narwhal*, one of Uncle Sam's largest submarines. She carries a crew of eighty-eight and can do seventeen knots an hour at the surface

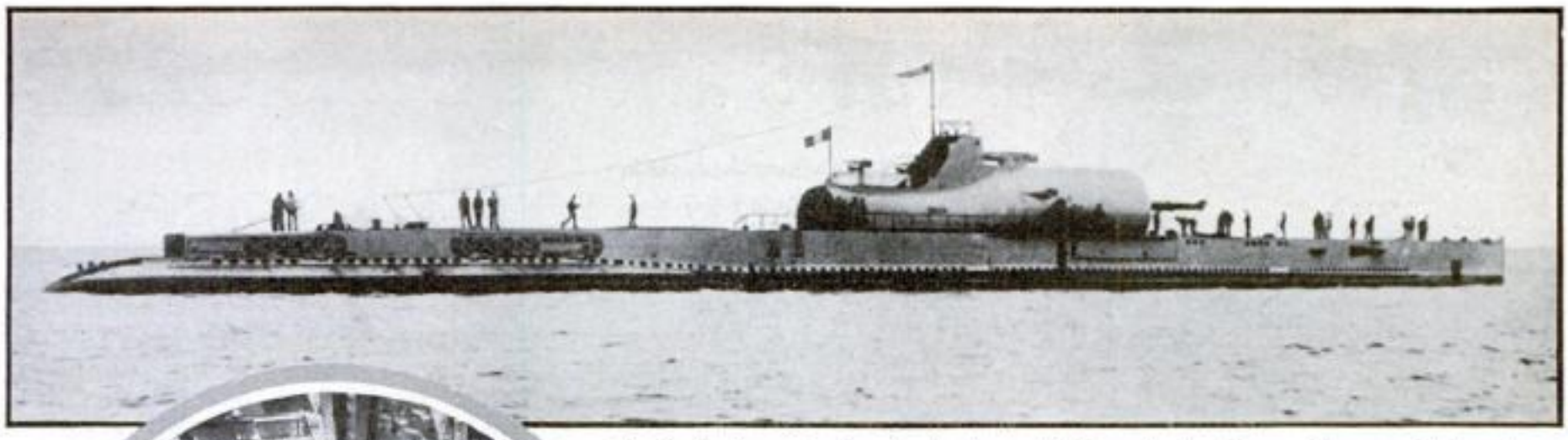


On the broad deck of the *Narwhal*, a gun crew drills with one of the two six-inch guns mounted on this formidable undersea cruiser. The huge vessel's armament also includes six torpedo tubes

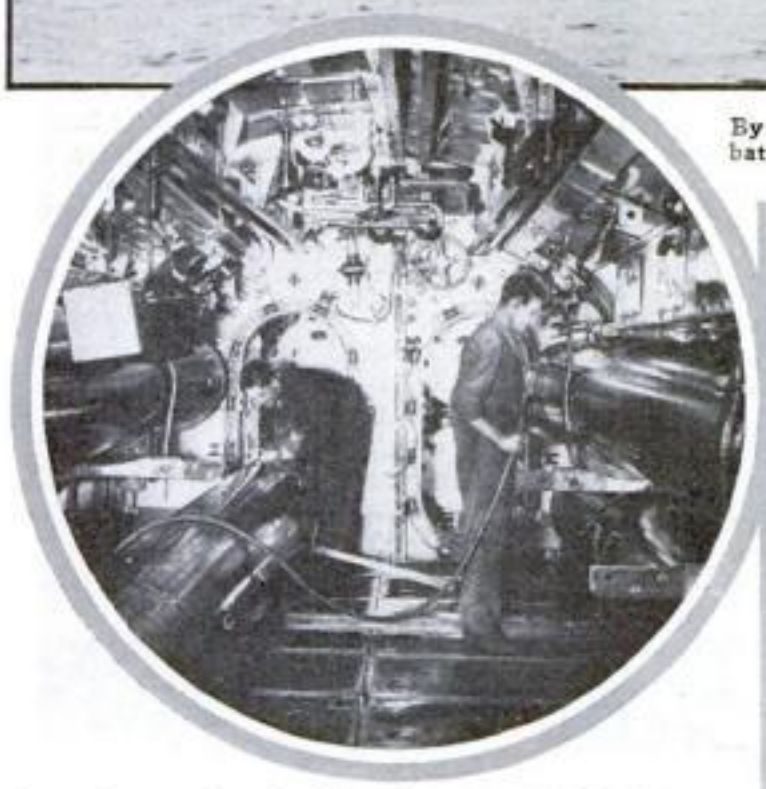
WILL naval battles of the next war be decided beneath the seas? With Germany building submarines again, after a sixteen-year lapse imposed by treaty restrictions, the eyes of naval observers the world over are turning once more to undersea craft and their potential value in future conflicts. Increased speed and cruising radius, together with powerful weapons for defense at the surface, make them a puzzling factor in the problems of sea power.

Compare recently built submersibles with the relatively small U-boats that wrought havoc on allied and neutral shipping during the world war, and the startling evolution of the submarine since that time becomes apparent. France's 400-foot *Surcouf*, largest submarine in the world today, is a veritable armored cruiser of 3,000 tons displacement; a pair of eight-inch guns supplements its heavy battery of fourteen torpedo tubes, and enables it to cope with all but the most powerful of the enemies it may meet at the surface. Hardly less formidable are the United States Navy's cruiser-type submarines *Narwhal* and *Nautilus*, 371-foot monsters of 2,730 tons mounting six-inch guns; and its mine-laying submarine *Argonaut*, about equal in size, carrying six-inch guns and sixty mines.

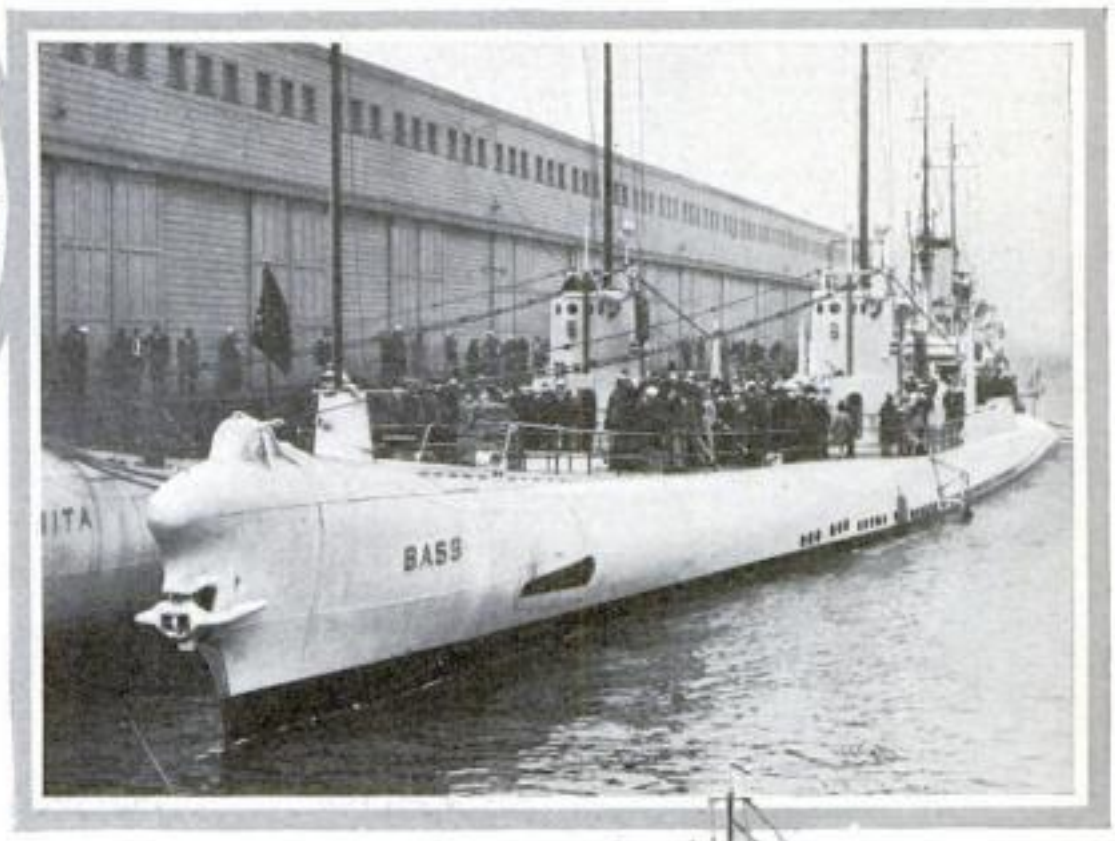
No longer is the wartime role of a submarine limited to comparatively short raiding cruises from its shore base. Undersea craft of today are speedy enough to accompany a battle fleet on its maneuvers, participating in attacks and performing invaluable scouting missions. Their cruising radius is far more than sufficient to take them across an ocean and



By far the largest submarine in the world, France's giant *Surcouf* is a veritable undersea battleship. It has a turret mounting two eight-inch guns, and will carry an airplane



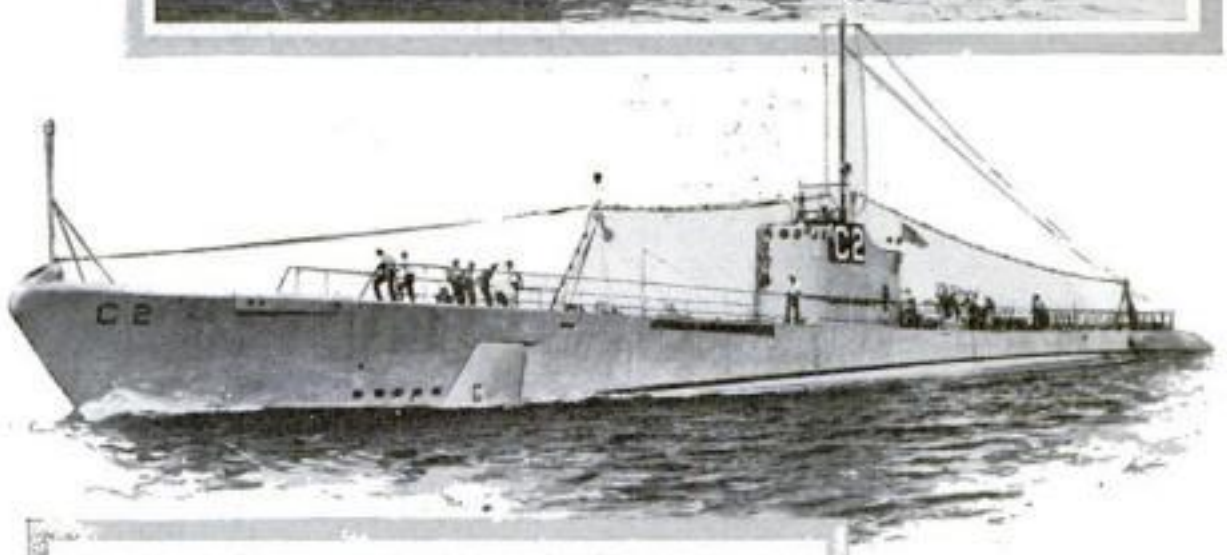
Preparing torpedoes for firing, aboard the British *L-56*. The man at the right is giving a projectile the 2,000-pound charge of compressed air that will drive its propellers



back again without refueling. Their newly acquired ability to defend themselves, if caught unawares upon the surface by hostile war vessels, enhances their ability to operate in comparative safety in waters controlled by an enemy.

How keenly the leading world powers realize these capabilities of the modern submarine is shown by their development of this naval arm. So rapidly has France increased her undersea power within the last few years that she now leads all other nations in number and tonnage of submarines. The United States ranks second in number, and third in tonnage. Figures revealed not long ago by the Office of Naval Intelligence at Washington, D. C., give the following totals of submarines built and building: France, 111; United States, ninety-four; Italy, seventy-five, Japan, seventy-three; British Empire, sixty-four. The corresponding tonnages, in round figures, are: France, nearly 100,000; Japan, 88,000; United States, 83,000; British Empire, 64,000; Italy, 52,000. From other sources, Russia is unofficially reported to be building some sixty submarines of about 800 tons apiece; while Germany's announced plans call for twenty-eight "pocket submarines" of from 250 to 750 tons.

Views reproduced on these pages give a vivid impression of the power of modern supersubmarines. Their interior details are carefully guarded secrets; but recent photographs made by special permission aboard an earlier type—the British submarine L-56—afford a glimpse of the maze of machinery below decks that propels such undersea warships and launches their death-dealing torpedoes.



The U.S.S. *Cuttlefish*, 1,110-ton submarine of recent design. This undersea fighter has a surface speed of seventeen knots. Above it are pictured the *Bass* and the *Bonita*, 2,000-ton prototypes of the larger *Narwhal* and *Nautilus*. The *Bass* carries a three-inch antiaircraft gun

The gun crew of the *L-56* prepares for action. British submarines of this class are armed for surface fighting with a four-inch gun, as shown, and a machine gun

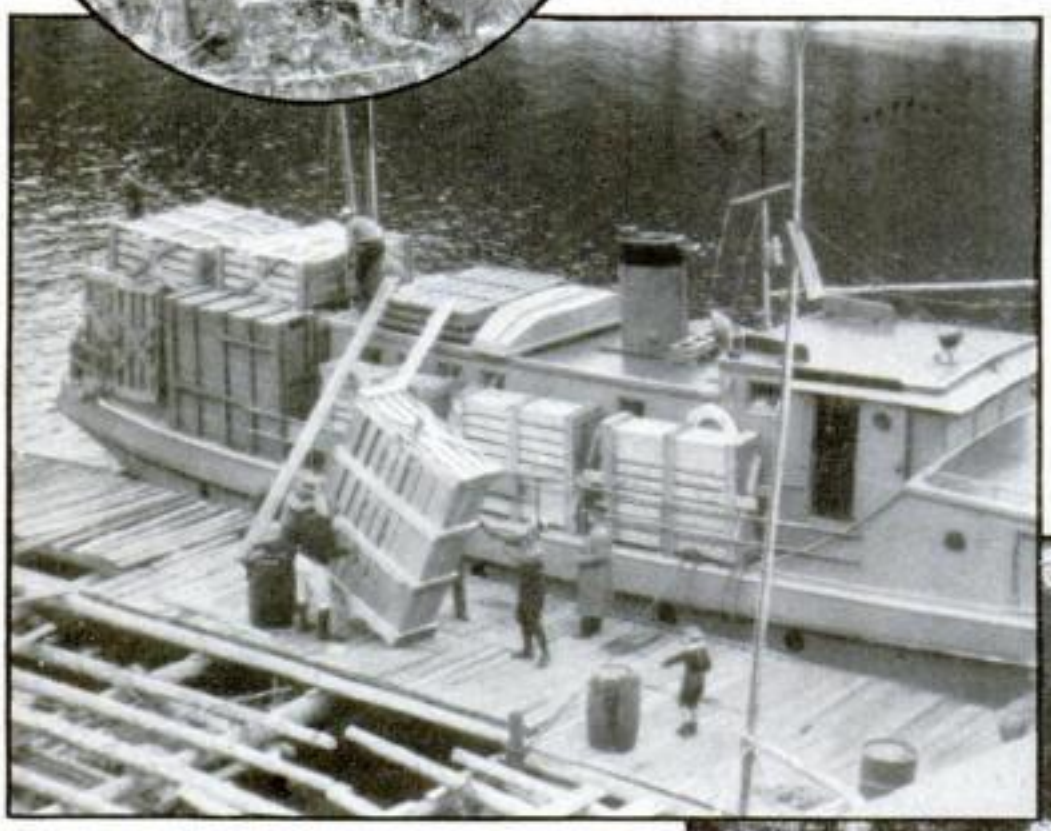
Traps and Boats Save Starving Moose

A captive calf. One of the eleven moose trapped to save them from starvation

TRAPPING moose, the biggest game animals in America, has been the exciting job of two experts of the Michigan State Conservation Department, Paul Hickie and Ellsworth St. Germain.

In huge box traps, they have been catching members of a herd of starving moose on Isle Royale, in Lake Superior. The first of this herd are believed to have crossed the ice from Canada about 1912. By 1934, their number was estimated at more than 1,000. A food shortage had already begun, and during the severe winter hundreds died. Michigan conservation officials took action and during the last winter Hickie and St. Germain began their work.

Isolated except for communication with the mainland by radio, the men cut high branches to provide food for the herd. They built traps and corrals. In them, they caught eleven moose, including one 1,000-pound bull. In the spring, the animals were transported in crates by boat to the Michigan mainland.



Transferred from the corrals to crates in the spring, the moose were transported by boat to the Michigan mainland. Two were shipped to the Detroit Zoo, the others to a game preserve

Isolated from the mainland except for communication by radio, two experts of the Michigan Conservation Department made the lonely cabin (right) on Isle Royale their winter base camp

The photograph below shows a moose about to enter one of the stoutly built box traps. The trigger operating the automatic drop door was baited with freshly cut balsam browse

Once trapped, the starving Isle Royale moose were safe; each high-fenced corral had its well-stocked feed pile

From Coast *to* Coast

IN A MODERN AIRLINER

EFFICIENT ORGANIZATION AND MARVELOUS MACHINES SET A NEW STANDARD OF COMFORT, SAFETY, AND SPEED IN AMERICAN TRAVEL

By George R. Reiss

THE other evening, I heard a business executive give his opinion of the passenger air lines.

"Air travel," he said, is just a fad. When the air lines are perfected so that they come within reach of the average man's pocketbook; when they deposit the Philadelphia-bound passenger in Philadelphia 100 times out of 100, instead of in an isolated cow pasture; when they become really safe—we'll use the air lines. But," he added, triumphantly, "that will never come in our day."

Partly true, but only partly true. The 1935 air lines are not 100 percent safe; they are not yet 100 percent dependable; they are not quite within the reach of the average man's pocketbook. But neither are the railroads, steamship lines, bus lines, trolley lines, or private automobiles.

The air lines' utopia is almost within grasp. Their record for safety, dependability, and cost now compares favorably with that of other forms of transportation—and it still is due for a big improvement. Virtually every major problem of the air lines has been solved within the last five years.

Witness just a few of the inventions and improvements in aerial equipment the last five years have brought forth: the radio beam, the adjustable-pitch propeller, ice-removing equipment, improved weather-forecasting methods, radio blind-landing equipment, the robot pilot, more powerful motors with less weight, and improved streamline design.

All these have put American air transportation on so efficient a basis that lines last year inaugurated sixteen- to twenty-hour transcontinental service, at least five times as fast as the best rail service, and established fares that are almost on a par with rail and Pullman fares. Major lines completed on time ninety-five to ninety-nine percent of all scheduled trips; and your chance of getting killed, if you flew only on major lines, was not over one in 50,000,000 for every mile you flew. In fact, you took a much bigger risk in your automobile.

Travel with me on a major air line to see how these new inventions work. Ride with me from New York to Los Angeles on the "Sky Chief," the fastest coast-to-coast schedule.

I put my money down on a counter at New York and request, "One ticket for Los Angeles."

What do I get in return? I get speedy, comfortable, and safe transportation. By rail, I would leave Sunday afternoon and arrive in Los Angeles the following Thursday. By air, I reach my destination Monday morning. By rail the fare is approximately $134.50 including lower berth, meals for four days, and tips. The air fare, including my taxi bills, is $161.50. For $27 extra I have saved four days.

And what does it take to transport me? It takes a gigantic machine that clicks with the precision of a high-grade watch. It takes an $80,000 airplane; four transport pilots; mechanics, dispatchers, clerks, weather observers by the score; five big airports; a dozen radio stations; more than 100 emergency fields, and 500 airway beacons.

At the airport, our plane is waiting, an eye-filling sight. It is eighty-seven feet wide, weighs nine tons, and embodies all the latest features in streamline design and safety features. It gives a feeling of great strength, of security, like the George Washington Bridge.

The plane is ready. Hundreds of gallons of gasoline have been poured into the big tanks; every bolt and nut has been inspected and tightened; the radio has been tested; the whole outfit has been passed by the ground staff, and the engines have been warmed. The baggage and the air mail have been stowed in the ample cargo hatches back of the pilots' cockpit and in the tail.

The weather looks doubtful; it is raining hard, and it seems hardly a fit day for flying; but the pilot doesn't look worried. One hundred miles away in the mountains, "Hell Stretch," it is foggy, but we shall see none of it, and at Pittsburgh the sun is shining.

In the operations office, our pilot is studying the big map which shows weather conditions in every corner of the United States. A teletype machine chatters with additional weather reports from the score or more of meteorological stations strung across the Jersey plains, through the Alleghenies, over the flats of Ohio and Indiana.

If the weather were doubtful, the plane would be held. You might fret and fume; you might threaten to sue; yours might be a life-and-death errand, but the plane would be held until the situation cleared up. In aviation, there is no such thing as, "I guess we can make it," or, "I hope we can make it."

But, this time, the pilot is satisfied; the field manager is satisfied; they sign clearance forms.

But here a word about the most vital element of this gigantic system, the human element. Our boss pilot is a straight, clean, well-built, military-looking man about thirty-five years old. He is typical of the boss pilots you find on these air lines; he learned to fly in the Army, a hard school; he got his postgraduate course in the mail service. Flying is the only profession he knows. The copilot is a younger edition of the boss pilot.

It is now 3:58 P.M. A porter yells in the passenger station:

"All abo-o-o-ard; Chicago, Kansas City, Albuquerque, Los Angeles."

The passengers file down the canvas way stretched from the station to the door of the waiting ship. The agent examines their tickets, checking them against his manifest. The pilot is in his cabin; the copilot is at the rear of the cabin facing forward. As we enter, he takes our coats and hangs them on a rack.

The starboard motor already is roaring, the ship vibrating from its pull. The field manager

A pilot studying weather reports with the meteorologist and the dispatcher. Below, the map which shows existing weather condition

The pilots' cockpit, illustrated below, is a bewildering maze of dials and controls

eyes his wrist watch, then the pilot; then his hand drops.

The door is slammed, the motors roar, and the giant ship rolls majestically off the concrete apron.

At the end of the runway, the pilot holds the machine on the brakes and turns up the motors, first the left and then the right; we listen to the thundering of the bottled-up power of 1,420 horses, enough to pull a half hundred freight cars. The pilot is satisfied. He releases one brake, and the plane swings around into the wind. Then he feeds the power of those 1,420 horses into the two motors. The plane suddenly lurches forward; the tail comes up; the bumping ceases, and we're in the air.

Before we pass the edge of the field, the teletype machine in the operations office is chattering again; it is telling meteorological stations, beacon tenders, field managers, dispatchers, clerks, and pilots that No. 312, Pilot Williams, has started; that "the Chief" is in the air.

From now on everything must click, every operating cog must mesh.

In a moment, the Jersey marshes fade. Suddenly, we see only a gray void where the earth had been. We are in the clouds; the machine climbs steadily, smoothly, without a quiver.

Interior of the cabin of a modern airliner. Noise and vibration are reduced to the minimum, and the temperature is automatically controlled. Below, a giant transport plane in flight, with its wheels retracted into the engine nacelles

Now we are flying blind; but no need to worry. The pilot knows his job. With the instruments in his cabin, he could fly all the way to Chicago without looking out of the cockpit. He has his compass, his altimeters, his bank and turn indicators, his artificial horizon, and his radio range finder to guide him unerringly.

But it wasn't always that way. Many good men paid with their lives for those instruments. Ten years ago, blind flying was known as "seat-of-the-pants" flying, for fog-bound pilots without instruments soon learned to tell whether they were flying right-side-up by the pressure against their parachute packs.

Suddenly, we burst into sunshine and find ourselves skimming along the top of a great mass of tumbling white clouds. We have our first impression of speed as the clouds flash along close beneath the bottom of the wing. The roaring of the motors is lessened. We are nearly three miles above the earth.

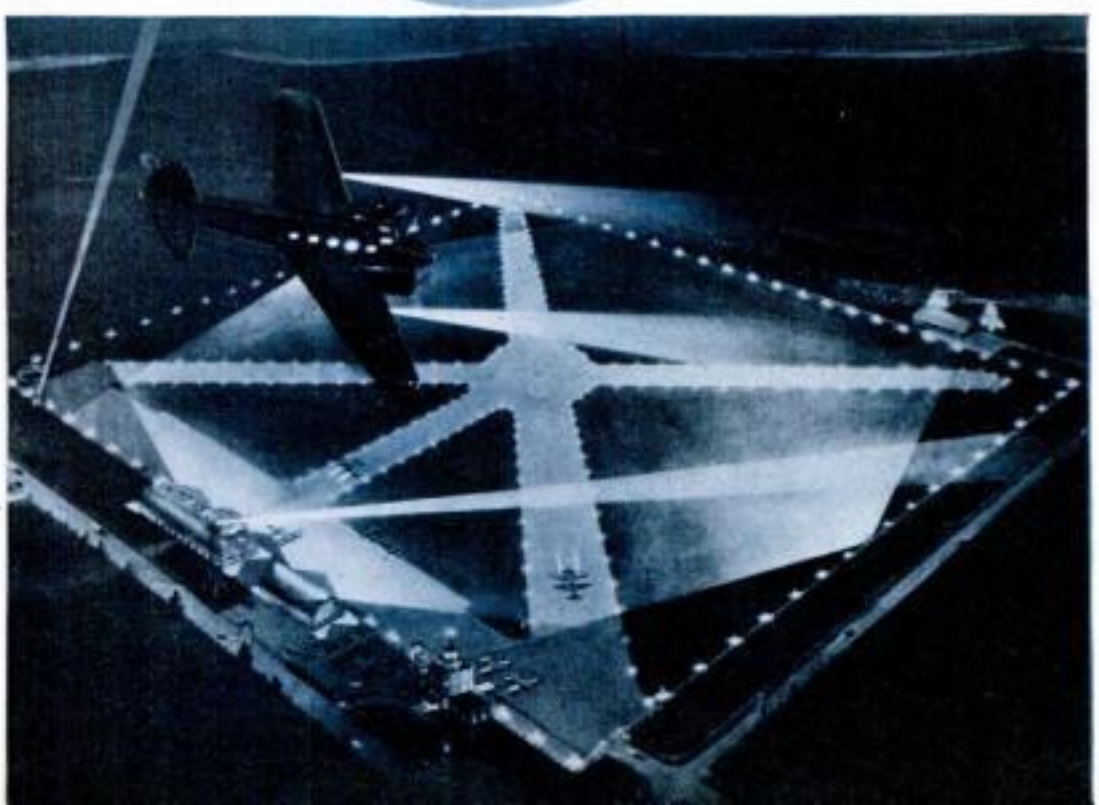
On this flight, your Adam's apple gets a workout. You quickly learn to swallow often. That relieves the pressure on your eardrums caused by the altitude changes.

The copilot comes along the alleyway, methodically taking the tickets. Then he walks aft to the kitchenette and busies himself with the boxes and vacuum jugs. Fitting a little tray over each seat, he serves luncheon—fruit salad, sandwiches, cake, fruit, and coffee. When the tables are cleared away, he makes the passengers comfortable by adjusting their seats and furnishing pillows to those who want them. Then he retires to the cockpit, leaving the door open.

Now we may examine our airplane. It is the latest and finest triumph of the aeronautical engineers. It is as far ahead of the 1925 plane as the Twentieth Century Limited is ahead of the Lincoln funeral train; as far ahead of Louis Bleriot's cross-channel plane as the latest streamline train is ahead of the Pony Express.

It is a low-wing, all-metal monoplane, with two 700-horsepower motors jutting forward of the wing. The cabin is a huge affair. There are fourteen seats, big, upholstered, adjustable seats as comfortable as the overstuffed furniture in your living room. Beside each is a reading light, an ash vent, a push button to summon the copilot, and a nozzle to regulate the flow of air. At the rear of the cabin is a lavatory and the kitchenette.

No matter what the temperature may be out-



A plane swoops down for a night landing

doors, there is a constant temperature of seventy degrees in the cabin. It may be twenty below outside—and it frequently is at 14,000 feet—but it remains seventy inside. The cabin of the plane is steam-heated and air-conditioned.

The expected thundering of motors is missing. You may talk in normal tones. In fact, the copilot tells us the pilots frequently must ask passengers at night to talk in lower tones so as not to disturb their fellow travelers who are sleeping.

This is the result of soundproof construction, the rubber mounting of the engines, and the fact that the three-bladed propellers are geared to revolve at comparatively low speeds.

Each of the two motors can supply power enough not only to keep us aloft, but to climb. If a motor fails in flight, we can continue the journey. Failure of one motor is unusual; failure of two motors is virtually unheard of. And motor failures are becoming increasingly rare.

In the air, the wheels retract into the engine nacelles. This cuts down resistance and increases the plane's speed by twenty-five or thirty miles an hour.

One of the most remarkable features of this plane is its adjustable-pitch propellers. These are regulated by the pilot from his cabin to give the greatest possible efficiency. In taking off, he adjusts the propellers to low gear, or low pitch, and gets maximum power, just as you put your automobile into low gear to climb a steep hill; in the thin air of high altitude, he shifts to high pitch so that the propellers take bigger bites and the plane gains maximum speed.

Another feature is the wing flap or air brake. This is merely a hinged section of the bottom of the wing which may be raised or lowered at the will of the pilot. Without the wing flap, this plane lands at seventy miles an hour and requires a huge field; with the flap, it lands at fifty-five miles an hour and may be stopped in one third the distance.

The most popular transport of three to five years ago had a top speed of about 145 miles an hour and a cruising speed of about 120. Under favorable conditions it could climb, fully loaded, to about 16,000 feet, and fly 500 miles without refueling. This plane has a top speed of 215 miles per hour and a cruising speed of 195; it operates most efficiently at altitudes of 12,000 to 14,000 feet, and has a range of 1,300 miles.

And in this tremendous speed and range lies the secret of the plane's success in bringing the air lines out of the red. It carries a larger pay load and flies over fifty percent more miles in the same number of hours in the air. This is an important factor, since pilots' pay, maintenance, depreciation, and other charges are based on number of hours in the air.

It is a thirsty brute. It burns ninety gallons of gasoline every hour, one and a half per minute, against the old transport's sixty—but that is approximately the same fuel mileage for a much larger load.

Our plane soon will be equipped with another of the new safeguards, the ice remover. Ice is one of the airliner's biggest dangers. Under certain weather conditions, ice may quickly form on the propeller blades, causing vibration sufficient to tear loose a motor, or may form on the leading edges of the wings, destroying the lifting characteristics while adding to the weight. Ice is blamed for some of aviation's outstanding disasters.

The ice remover consists of soft-rubber sheathing to cover the propellers and a rubber covering for the leading edges of the wings and tail surface. If ice begins to form, the pilot turns a switch and the principle that operates the wiper on your automobile windshield is pressed into service to keep the rubber pulsing and to crack the ice, which is then blown away by the slipstream.

In addition to all the weather information gathered before the start, the pilot regularly receives more by radio. If the weather shows any change, the pilot is called and advised. In fact he is doubly advised, for the Department of Commerce is broadcasting the weather along the whole airway at short intervals.

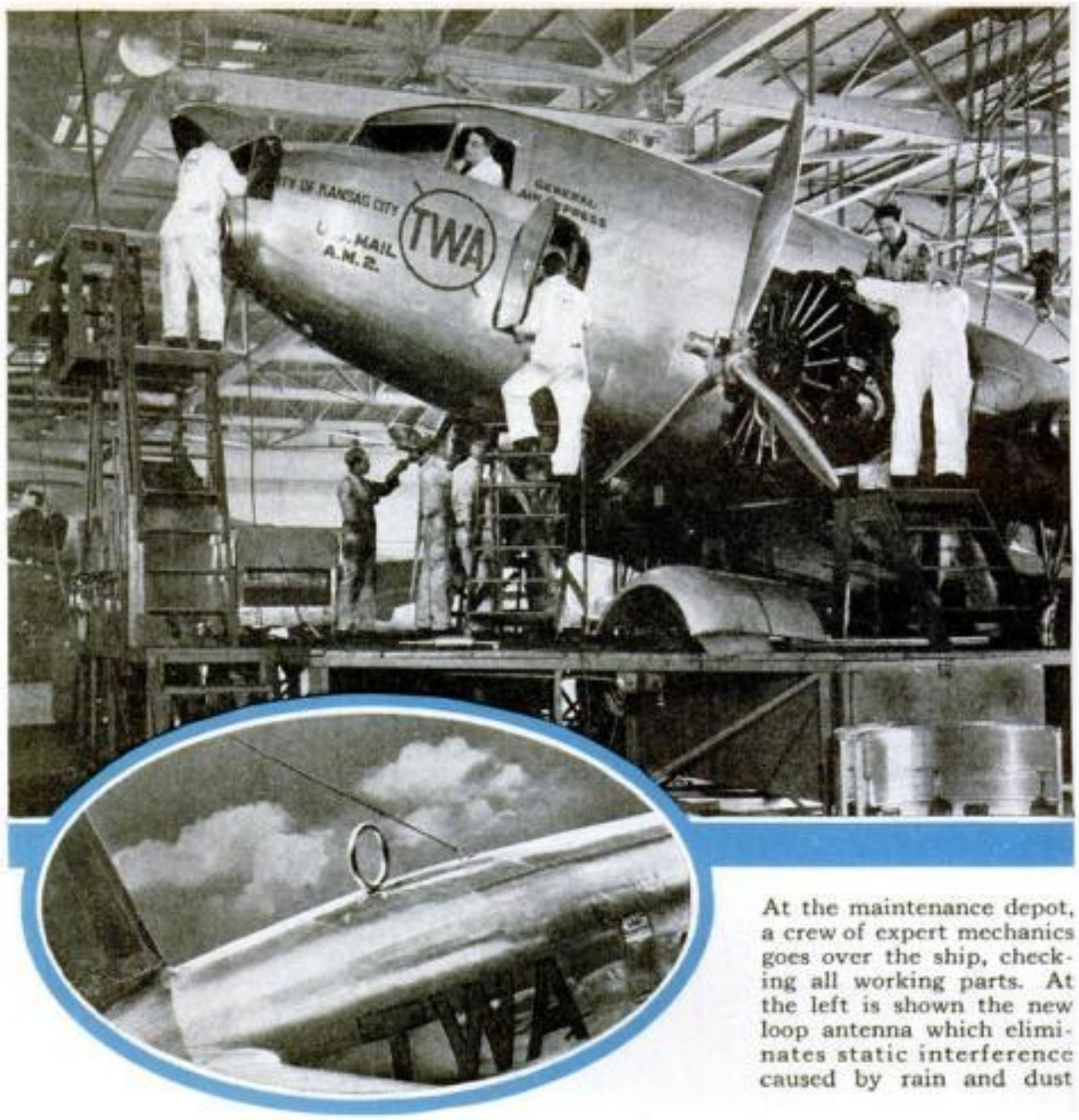
This ship is constantly in touch with the ground. It is called every twenty minutes on a set schedule. It is time for a report. The pilot hands us an extra set of earphones.

"Calling Williams in 312," says a voice. "Go ahead, Bill."

The pilot plucks his transmitter microphone from its place and speaks into it:

"Williams in 312; Williams in 312; flying 14,000 feet over Harrisburg; over clouds."

The airport repeats the message as it is typed for record, and then signs *(Continued on page 109)*



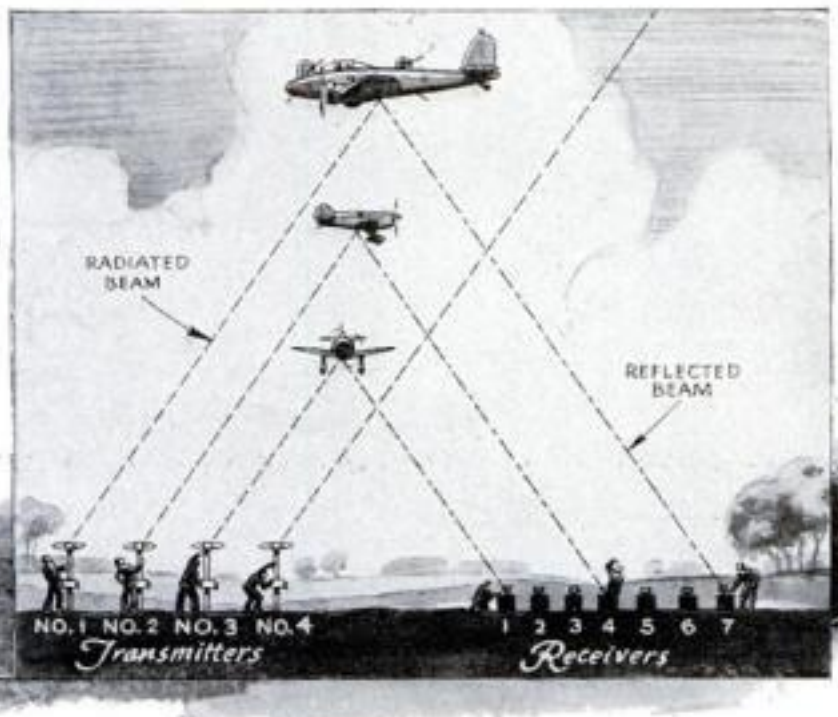
At the maintenance depot, a crew of expert mechanics goes over the ship, checking all working parts. At the left is shown the new loop antenna which eliminates static interference caused by rain and dust

Lined up on the field, these huge planes have the graceful poise of birds.

In a dramatic test of the U. S. Army's mystery-ray detector for hostile ships, the device trained a searchlight on the Coast Guard cutter *Pontchartrain,* maneuvering far offshore in the darkness, as depicted above by our artist

Mystery Ray Locates "Enemy"

U. S. ARMY TESTS DETECTOR FOR HOSTILE SHIPS AND PLANES



Portable transmitting unit of the German ultra-short-wave field equipment for detecting enemy aircraft. Diagram shows how plane reflects the radio beam. At right, close-up view of the diminutive transmitting unit

ARMED SENTRIES barred visitors from approaching within 200 yards of the Navesink Lighthouse Station on the New Jersey coast, a few nights ago. Behind the enforced barricade, U. S. Army experimenters were trying out a secret new weapon invented by the Signal Corps for use against possible invaders—a "mystery-ray" device reputedly capable of locating an enemy vessel as far as fifty miles at sea.

Twenty times the ray detector trained a huge mobile searchlight upon an invisible target — the Coast Guard cutter *Pontchartrain,* maneuvering without lights somewhere in the darkness offshore. Once, when the beam was lit, it grazed the vessel's stern. The other nineteen times, it struck the *Pontchartrain* squarely amidships, to score perfect bullseyes! Had the detector been used to direct the fire of the big coast defense guns at Sandy Hook, as it would do in war, the ship would have been at their mercy. Declaring the test a complete success, the experimenters prepared to try out the detector next for spotting hostile aircraft, another of its reported capabilities.

How the mysterious ray detector works is the Army's secret. The merest hint as to its nature is taboo, under stringent new regulations cloaking projects of vital importance to national defense. Whether it resembles a radio airplane detector recently reported under development in Germany, therefore, is open to speculation. The German apparatus is said to make use of the fact that ultra-short radio waves behave like light rays and are reflected by solid objects. When a curtain of parallel radio beams is projected skyward and receivers are suitably arranged, any plane intercepting the beams will reflect them back to earth and betray its position.

In this country, meanwhile, the "mechanical ears" used in listening for aircraft have been improved. Soundproofing shields the latest-type detector from exterior noises, so that it can work undisturbed amid city noises or in a howling gale.

Latest-type antiaircraft "ear." Soundproof shielding eliminates exterior sounds, so the instrument can work undisturbed in a gale

SUN'S HEAT OPERATES REFRIGERATOR

Otto H. Mohr, inventor of the solar refrigerator, with spherical lenses of various sizes

Diagram shows how solar ice box works. Light lettering describes what happens while sun is shining

WHEN summer sunshine beats down upon Concord, Calif., it makes things hot for every one but Otto H. Mohr. For him, it makes ice. By attaching a device that he has invented to harness the sun's rays to an ordinary refrigerator, he has provided himself with a food-storage compartment maintaining a temperature of twenty degrees or lower.

A small, box-shaped "solar unit" designed by Mohr provides heat that operates the ice-making apparatus, much as a gas flame makes ice in a gas-operated refrigerator. A spherical lens in the unit collects the sun's rays like a burning glass, operating at constant efficiency regardless of the position of the sun. How the rays, concentrated upon a reservoir of ammonia water, make ice is explained in the accompanying diagram. Two hours' daily exposure to the sun is reported sufficient for preserving food for a household.

Larger solar units have been designed by Mohr for air-conditioning an entire house at negligible expense. In winter, oil heated by the sun's rays is used to warm air, which is then circulated through the rooms by means of registers. In summer, the air is cooled, instead, by applying the principle of the solar ice box.

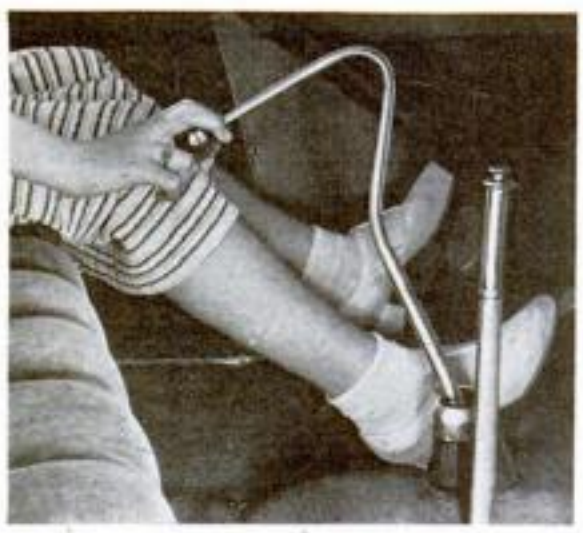
Solar unit for a refrigerator built into the side of a house. Some installations are portable

BICYCLE TAIL LIGHT HAS ITS OWN BATTERY

AN ELECTRIC tail light for bicycles, just placed on the market, is entirely self-contained. One standard flash-light cell provides current, which is turned on or off by a thumb switch located conveniently for operation while riding. Mounted on the rear mudguard, the lamp shows a red light to overtaking vehicles, while decorative side lenses display red and green lights respectively, in imitation of the navigating lights of ships and airplanes.

SCREW DRIVER LOCKS IN SLOT OF SCREW

NON-SKID screws have been devised to end the nuisance of a slipping screw driver. Their undercut slots lock the enlarged tip of the special screw driver used to insert them, as shown in the right-hand drawing. The screw driver is inserted or removed edgewise through the end of the slot, as shown at left.



CROOKED SHIFT LEVER SPARES RIDERS' KNEES

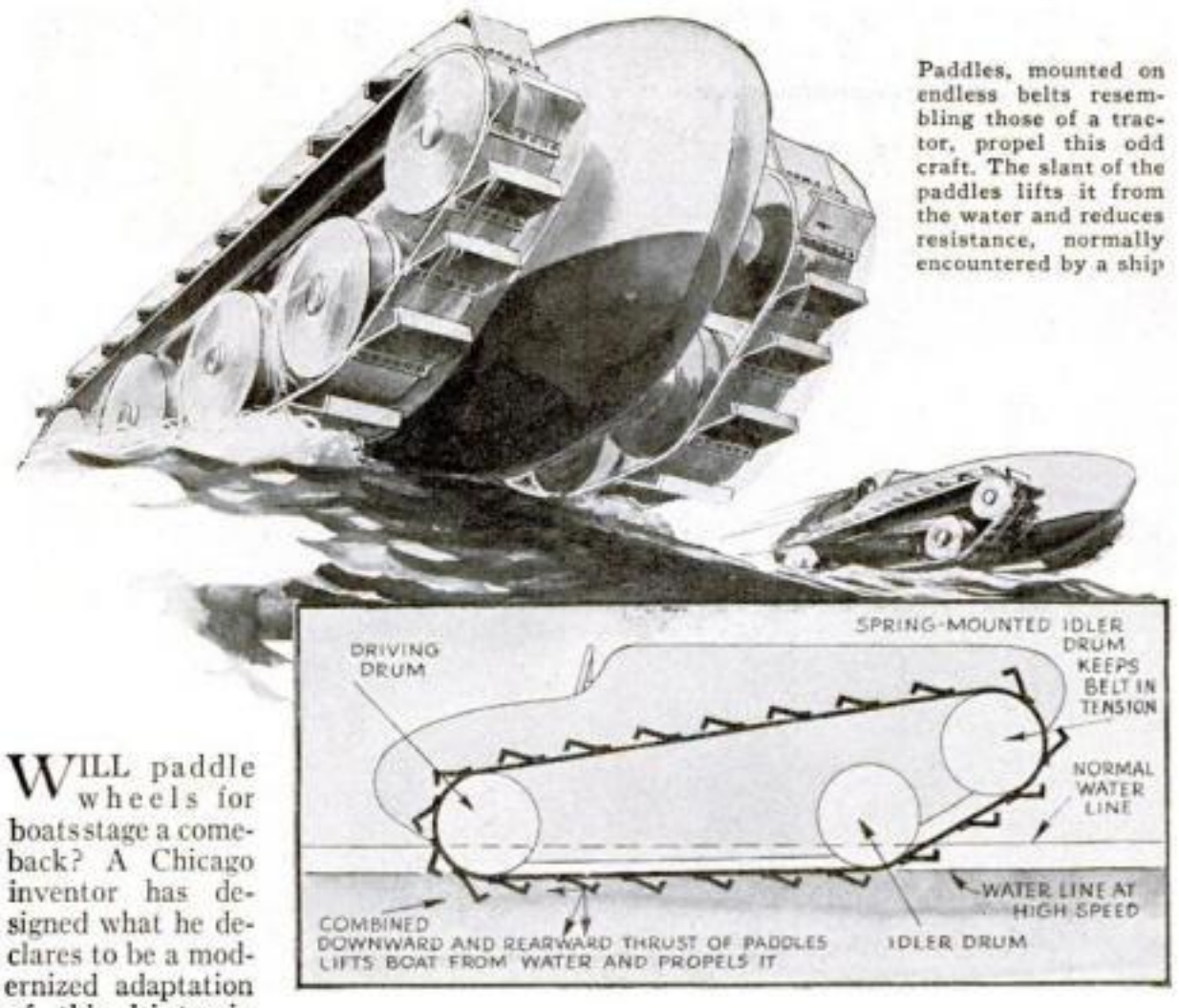
MORE ROOM for the occupants of a car's front seat is provided by a gooseneck gear-shift lever of new design. A bend in the shaft prevents the lever from bumping the knees of passengers, while keeping the handle within easy reach of the driver. It can replace an ordinary lever.

STREAMLINE BOAT HITS HIGH SPEED

COMPLETELY enclosed in a streamline shell, a racing craft created by two California builders represents a new departure in speed-boat design. Powered by an automobile motor the new boat skims the surface of the water at high speed, as shown below, using a hydroplane step of standard design. It is made entirely of plywood.

Streamline speed boat in action. Note its resemblance to the fuselage of a cabin plane

Odd Tractor Boat Skims Water



Paddles, mounted on endless belts resembling those of a tractor, propel this odd craft. The slant of the paddles lifts it from the water and reduces resistance, normally encountered by a ship

WILL paddle wheels for boats stage a comeback? A Chicago inventor has designed what he declares to be a modernized adaptation of this historic form of marine propulsion. His plan calls for a boat that runs upon a pair of endless tracks, after the fashion of a land tractor, the tracks consisting of moving belts carrying a series of paddles. When power is applied to the belts through driving drums near the stern, they cause the paddles to sweep backward through the water, impelling the boat forward. At the same time, the planing action of the inclined paddles tends to lift the boat clear of the water, with the result that the hull skims the surface with a minimum of resistance. In consequence, the inventor maintains, a tractor boat of this type could attain high speed and could travel with a marked economy of fuel. The angle of inclination of the paddles would be suited o the weight of the craft; a heavy boat would have them mounted at an angle approximating forty-five degrees, while a lighter craft, requiring less lifting force, could employ more steeply inclined paddles to obtain greater forward traction.

CAMERA FOR NIGHT USE HAS LIGHT-BEAM FINDER

A CAMERA with a built-in flash light has been devised for making night photographs. When a button is pressed, the lamp lights up the surroundings and shows just how much of a scene will be included in the picture, dispensing with the use of a view finder. The original model was developed to aid the coroner of a midwestern city in making photographs at the scene of a suspected crime, but additional applications are foreseen in both amateur and professional photography.

LIGHTNING BLAMED FOR MOST CURRENT FAILURES

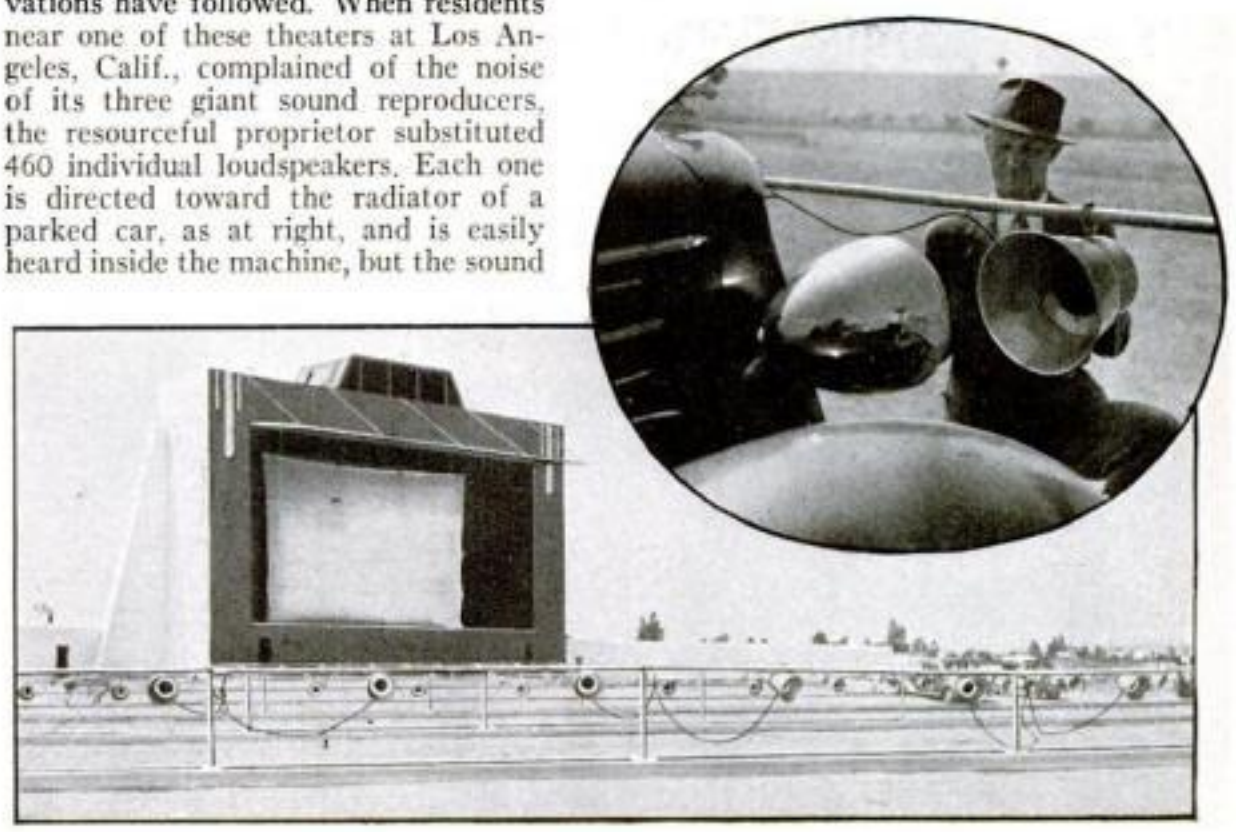
THREE out of four interruptions in electric service are caused by lightning, according to engineers who are seeking to reduce the figure by developing new protective devices for transmission lines.

GIANT HOMEMADE WATCH IS JEWELER'S EXHIBIT

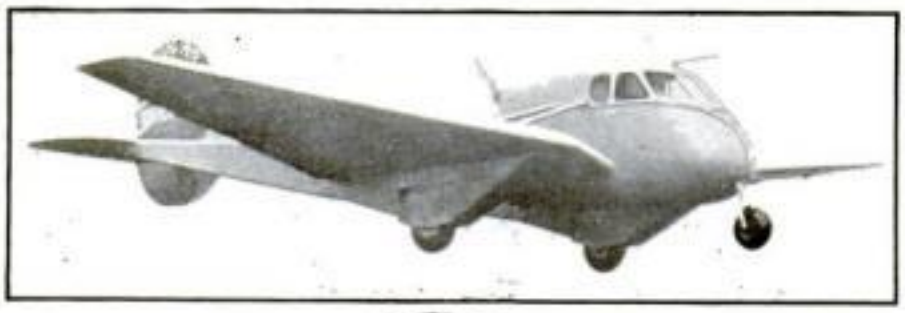
MAKING his own parts, a Columbus, Ohio, jeweler magnified a pocket watch a thousandfold to instruct his customers in the intricacy and delicacy of their timepieces. The giant watch, said to be the largest of its kind in the world, took five years to make, is built of metal, weighs 300 pounds and may be driven either by hand or by a motor. A window in the face makes the works visible for purposes of display and instruction.

AUTO THEATER HAS 460 LOUDSPEAKERS

SINCE the opening of the first "drive-in" theater, where motorists could enjoy talking movies without leaving their cars (P. S. M., Aug., '33, p. 19), the idea has spread to several parts of the country, and innovations have followed. When residents near one of these theaters at Los Angeles, Calif., complained of the noise of its three giant sound reproducers, the resourceful proprietor substituted 460 individual loudspeakers. Each one is directed toward the radiator of a parked car, as at right, and is easily heard inside the machine, but the sound does not carry to an appreciable distance. The ten-acre theater is said to employ the world's largest screen, measuring forty by forty feet, shown in the background of the photograph reproduced below.

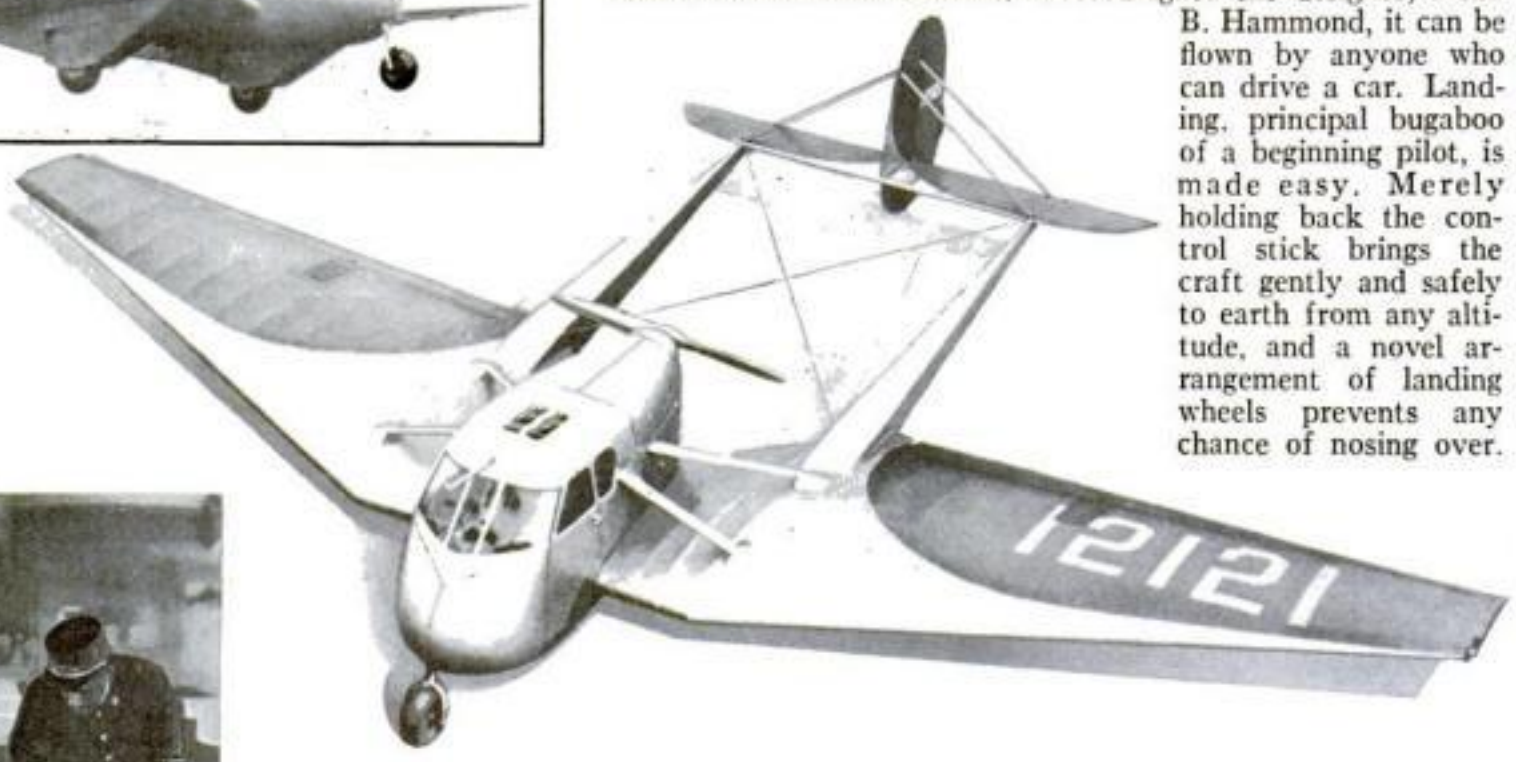


FLIVVER AIRPLANE DRIVES AS EASILY AS AN AUTOMOBILE



Flivver plane in flight during trials before officials of the Department of Commerce. At the right is a top view of the aircraft, showing the landing gear which makes it impossible to nose over when landing

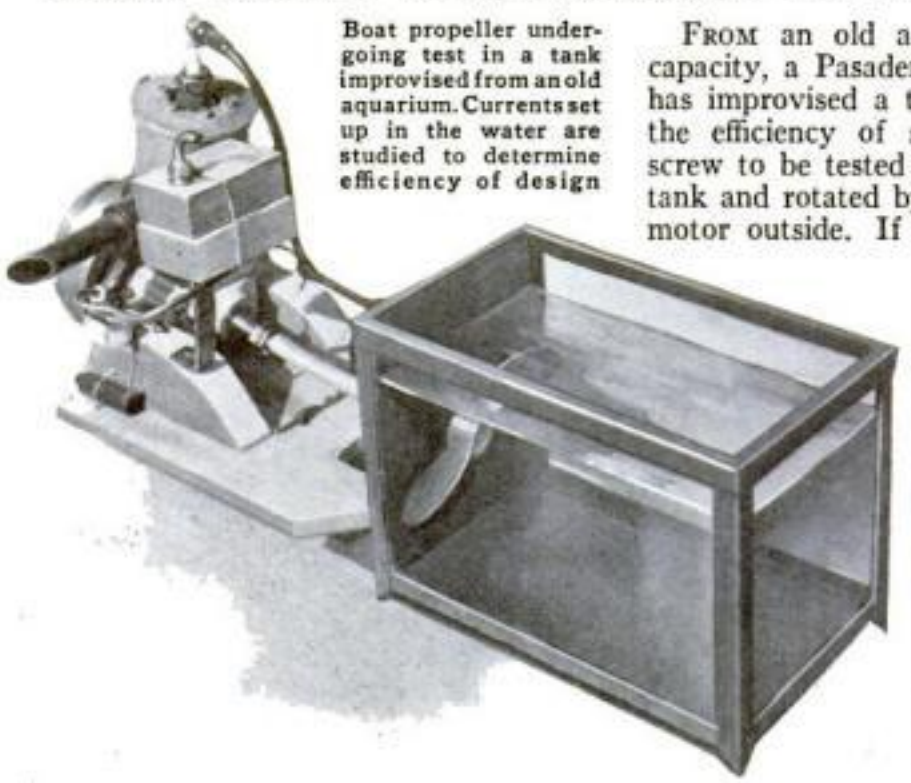
A "FOOLPROOF" flivver plane, first of fifteen similar craft ordered by the U. S. Department of Commerce in its effort to develop types suited for private flying, recently underwent trials before Government officials. According to the designer, Dean B. Hammond, it can be flown by anyone who can drive a car. Landing, principal bugaboo of a beginning pilot, is made easy. Merely holding back the control stick brings the craft gently and safely to earth from any altitude, and a novel arrangement of landing wheels prevents any chance of nosing over.



CHAIR-CAR SEATS HAVE LUGGAGE COMPARTMENTS

KEEPING luggage handy, yet out of the way, is made easy for chair-car travelers on the Canadian National Railways. Each of the revolving chairs is now provided with a compartment at the bottom, just large enough to accommodate one suit case, which a porter is shown stowing away in the illustration above.

TEST BOAT PROPELLERS IN AQUARIUM



Boat propeller undergoing test in a tank improvised from an old aquarium. Currents set up in the water are studied to determine efficiency of design

FROM an old aquarium of one-gallon capacity, a Pasadena, Calif., boat builder has improvised a testing tank to try out the efficiency of screw propellers. The screw to be tested is mounted within the tank and rotated by a gasoline or electric motor outside. If the design is efficient, the propeller forces the water rearward in a smooth spiral; but if the propeller is not correctly pitched, it will churn up the water. Poor propellers are also detected because they slow up the motor. Results of the tests have been applied by the builder in model power boats, driven by gasoline motors, and in full-size motor boats.

SPEEDING CAR REPLACES WIND TUNNEL

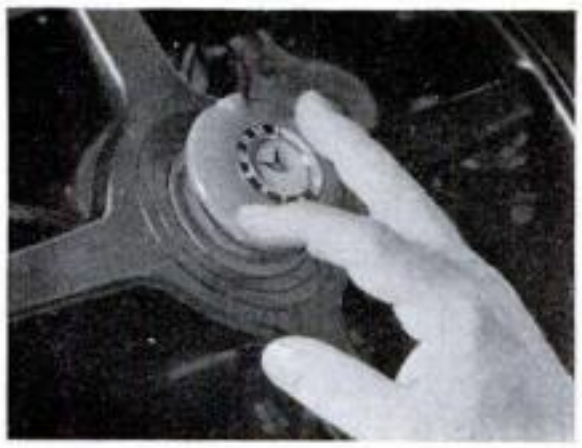
NEW DESIGNS for airplane wings may be tried out at a fraction of the cost of wind-tunnel experiments, according to an Inglewood, Calif., inventor, with a test car that he has devised. The wing section is mounted upon a platform attached to a standard automobile, as shown at left, and tubes lead from various points on its surface to gauges, enabling the pressure or suction on different parts to be recorded while the car is driven at a constant speed. The device recalls a substitute for wind-tunnel tests, developed in France, in which the model under test is attached to an electrically driven rail car for observations of its behavior in a flow of air.

COMPACT SCALE WEIGHS LETTERS AND PARCELS

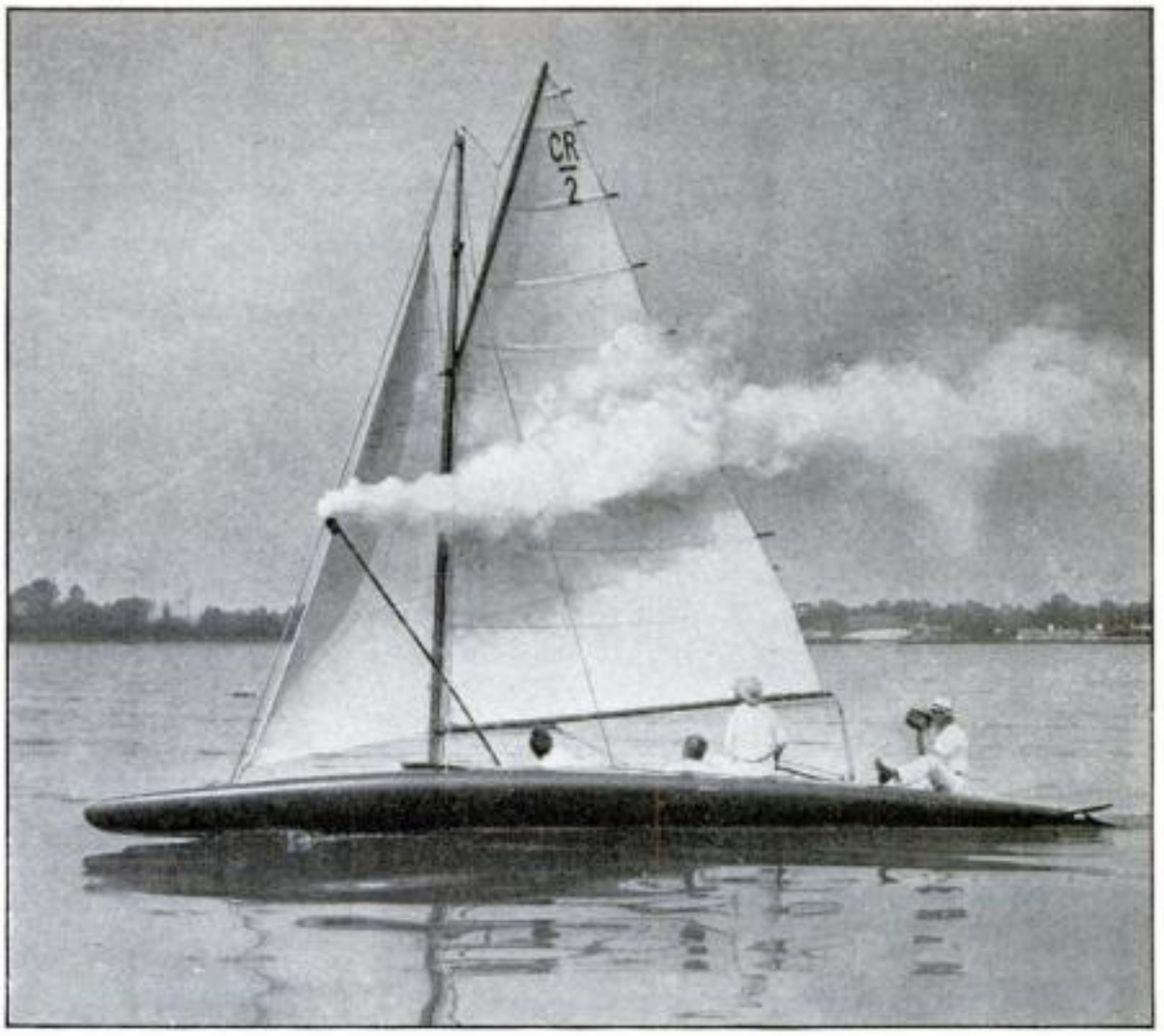
HANDY for weighing letters and small parcels, a new vest-pocket scale shows at a glance the postage required. When the device is held by a finger ring and a letter is clipped on, as shown above, a pointer shows the weight in fractions of ounces. A table on the counterbalance plate shows the postage rates.

HORN BUTTON HAS CLOCK MOUNTED IN ITS CASE

A COMBINATION horn button and timepiece for automobiles has been introduced by a Miami Beach, Fla., inventor. When the rim of the clock is pressed down, the horn is sounded. The inventor has also designed models with built-in vanity cases, for women motorists. In one of his designs, the winding stem is mounted at the rear, and the clock is wound by raising and revolving it. It is then replaced in the case on the steering wheel.



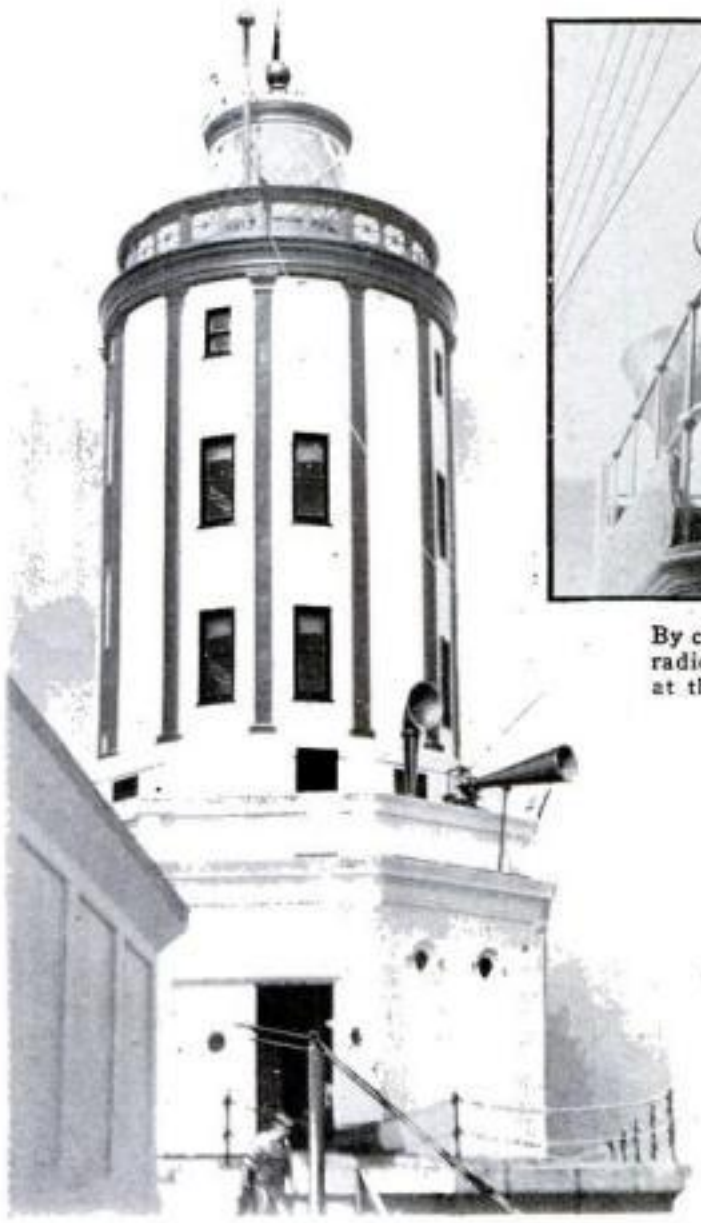
The latest in auto-horn buttons—a decorative clock and a combination clock and vanity case

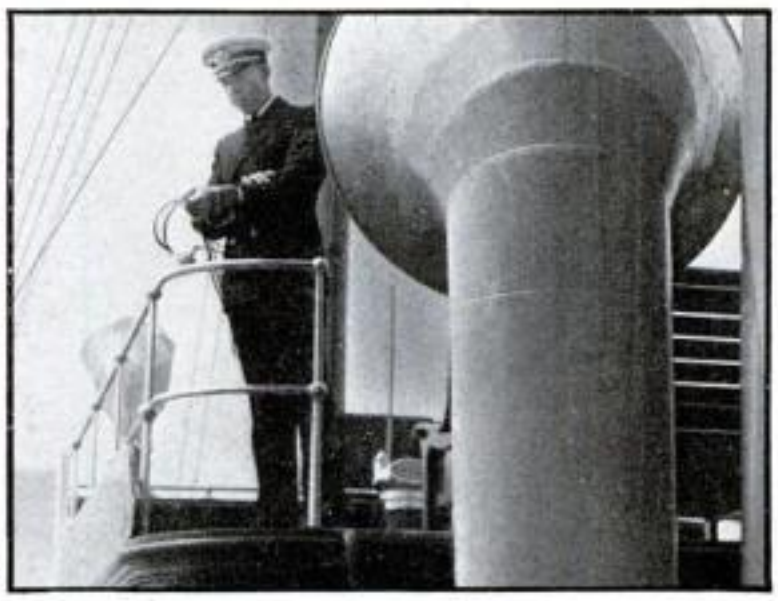


SMOKE TRAIL AIDS SAIL DESIGNERS

TO STUDY the way that breezes propel a sailboat, experimenters recently fitted a small craft with apparatus that releases a stream of smoke. The course of wind currents around the sails is made visible by the smoke and pictures are taken with a movie camera while the boat is under way. Improved types of rig for racing craft are expected to result from the studies. The picture above, taken during an experimental run, shows a photographer at the stern making movies of the smoke.

NEW FOG BEACONS USE TWO-TONED HORNS





By counting the elapsed time between the receipt of a radio flash and a sound signal from dual horns shown at the left, the officer calculates the ship's position

ALTERNATELY emitting a high-pitched scream and a low-toned boom, two-tone foghorns being erected at danger points along the Pacific coast will aid mariners to find their position. Radio flashes are transmitted simultaneously with the sound signals. By listening with a headset for the radio signal and counting the seconds until the arrival of the slower sound wave, a navigating officer can calculate his distance from a beacon. The two-toned signal is used in an effort to eliminate "dead spots" where foghorns of earlier, single-toned types have been found to be inaudible.

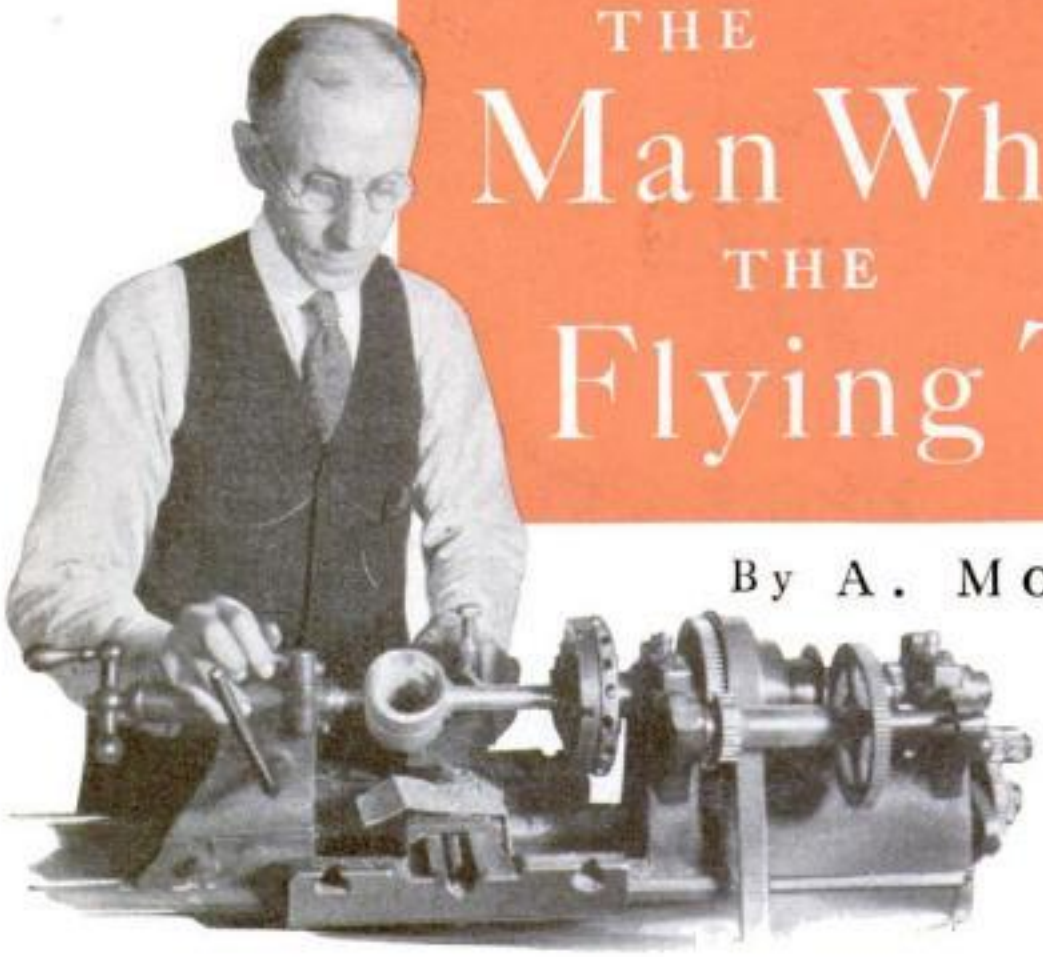
Reversible handlebars adapt this bicycle to tall or short cyclists. As shown, it is for a tall rider

HANDLEBARS ADAPT WHEEL TO ANYBODY

A BICYCLE designed by an Italian inventor has reversible handlebars. Riders of less than average height would use the handlebars in their conventional position, while a tall rider would reverse them for comfort. Changing the position of the handlebars occasionally during a long trip minimizes fatigue.

THE Man Who Builds THE Flying Trapeze

By A. MORTON SMITH



For twenty-seven years, Edward Van Wyck has been translating ideas of acrobats, tight-wire artists, and jugglers into equipment for their daring acts. Here he is putting the final touches on a bronze bearing housing for a loop-the-loop trapeze

WHILE stars of the circus are entertaining millions with sensational feats of daring on swaying perch poles, high wires, and the flying trapeze, a soft-spoken, middle-aged man sits at a work bench in his tiny shop in Cincinnati, Ohio, fashioning rigging on which these acrobats and aerialists will perform even more breath-taking and dare-devil stunts next season.

He is Edward Van Wyck, formerly a professional juggler. While he does not make all of the paraphernalia used by circus artists, he is the only man in America who devotes his time exclusively to the manufacture of circus rigging; at times he employs as many as six assistants.

Years ago, Ed Millette, an aerialist, had an idea for what he anticipated would be a sensational act. He would stand on his head on a wooden globe mounted on a high trapeze. The globe would revolve as the trapeze rotated in the opposite direction, creating an illusion of remarkable balancing skill. Fellow performers discouraged him. They said his idea was a pipe dream.

But Millette had trouped with Eddie Van Wyck, who, he recalled, made all of his own juggling equipment. So he went to Cincinnati, looked up Van Wyck, and explained his idea. "Give me two weeks to work it out," Van Wyck said. He tackled the job in his back-yard shop. Two weeks later, the equipment was finished and hung in a Cincinnati theater for a tryout. Millette was delighted, and took his novel rigging to New York where he joined the "greatest show on earth." His head-balancing act on the aerial globe was an outstanding feature of the circus season of 1908.

For twenty-seven years, Van Wyck has been working out just such far-fetched ideas for circus and vaudeville acrobats, aerialists, tight-wire artists, and jugglers. He moved his shop from his back yard to a down-town building, because circus folk came to his home and awakened him at all hours of the night to consult him about new props.

There is nothing ostentatious about Van Wyck's shop. It occupies a room twenty-three by twenty-eight feet on the ground floor of a two-story brick building. His name in black letters on the glass panel of the front door is the only identification. There is no machinery peculiar to his trade, except scores of molds for casting metal pieces used in rigging, which he has designed and constructed by hand as needed. Otherwise, he uses standard lathes, drill presses, and power saws.

Not all of his customers come to his shop to discuss their plans with him. Often they write or telegraph or cable from such far-away cities as Moscow, Bombay, Capetown, or San Francisco.

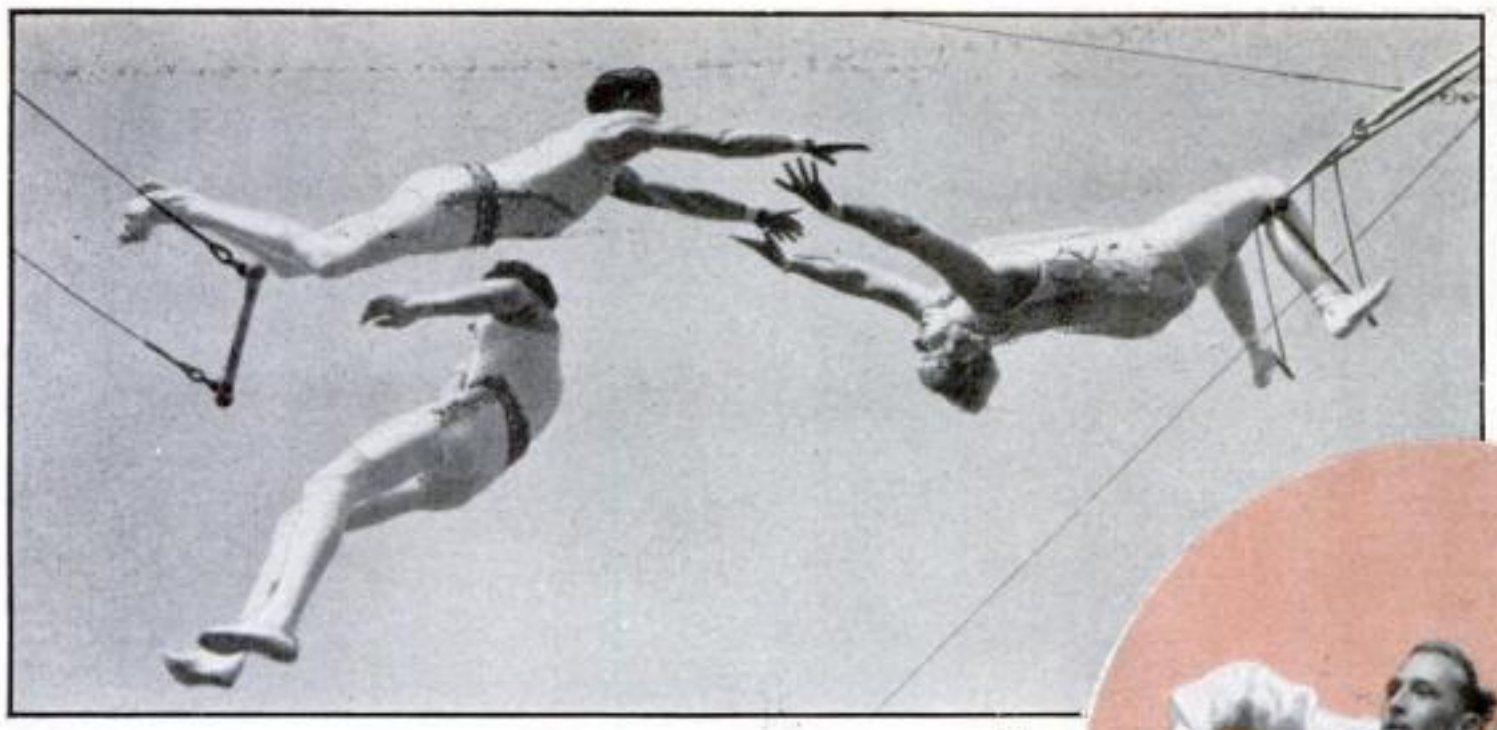
When a circus performer wants a new piece of equipment and its use is explained in detail to Van Wyck, he sketches it on paper to arrive at the proper dimensions and to determine the materials to be used. He has 6,000 sketches of every conceivable type of rigging filed alphabetically by the names of the troupes or individuals for whom they have been made. If he gets a rush order for replacement of some piece of equipment, his files afford him a quick reference for details.

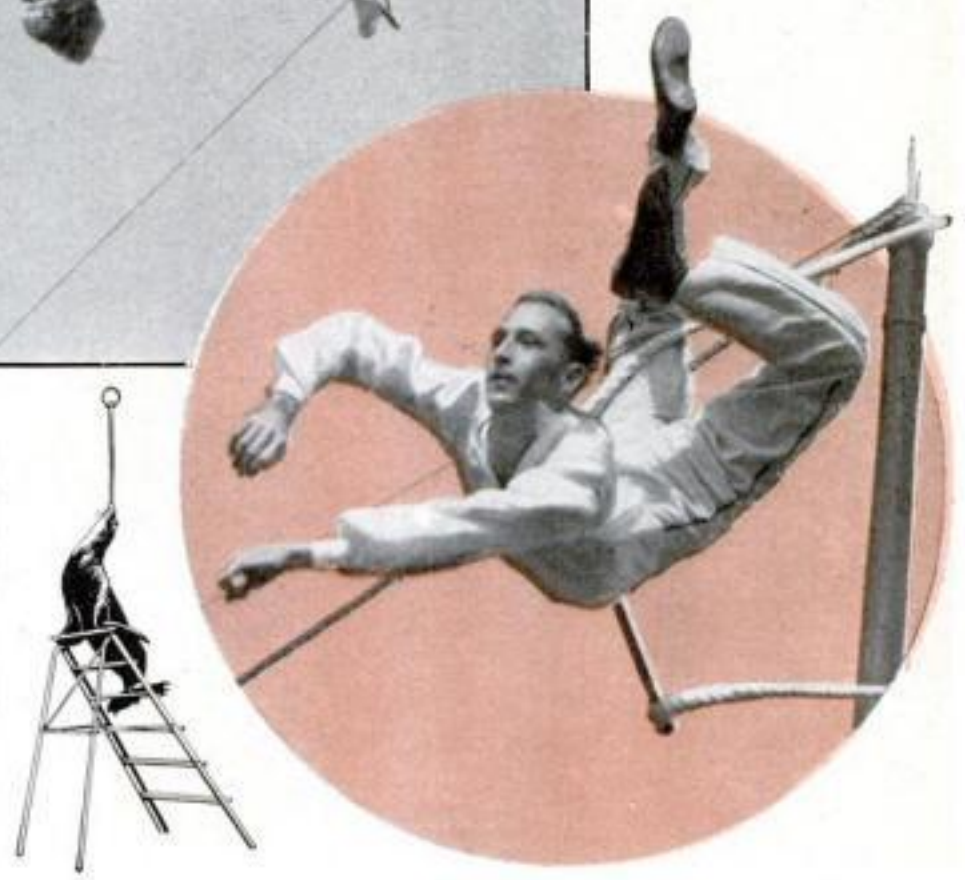
Con Colleano, the tight-wire wizard, does his breath-taking stunts on rigging specially built by Van Wyck

"There are two things about the construction of circus properties that must always be borne in mind," Van Wyck told me. "One is that equipment must be built of the lightest possible materials without sacrificing strength and durability. The other is that most rigging must be constructed in sections or to fold so that it can be dismantled and packed in small property boxes."

When Van Wyck has completed a sketch of a piece of equipment, he makes a second drawing, this time with crayon on the floor of his shop, reproducing the rigging full size. By this process, any impractical details not discernible on the paper sketch are revealed and he can check the dimensions and compare the equipment he is building with the floor sketch as he proceeds with his work.

"For instance," he said, "I once received an order from a well-known vaudeville comedian for a Japanese foot-juggling barrel six feet high. These bar-





CONFIDENCE These aerialists have implicit faith that their Van Wyck-built apparatus will not fail them. Note safety device supporting woman performer's legs. A heel-and-toe-catch artist, as below, relies on a trapeze having perfect balance

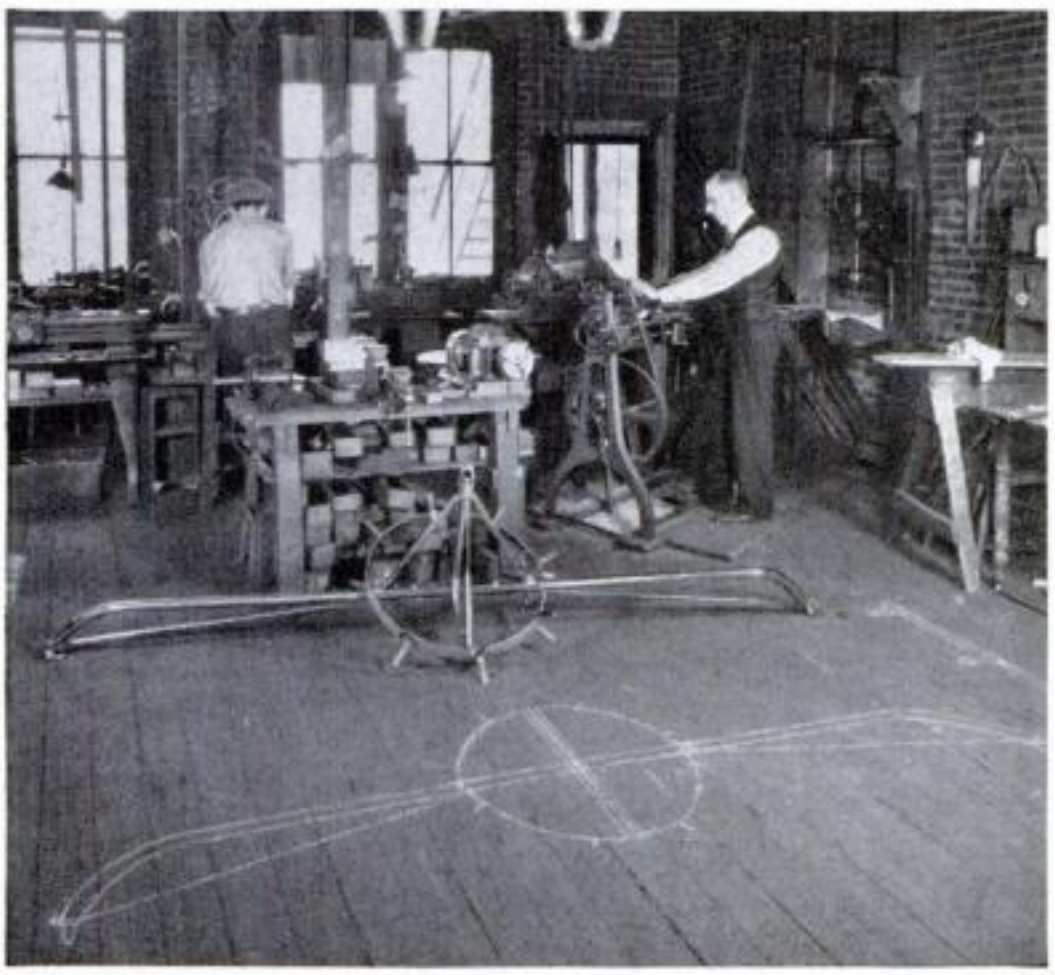
rels are usually thirty inches high. But the actor conceived the idea that a large barrel juggled on his feet would be a good novelty. I drew the barrel to scale on paper and then sketched it with crayon on the floor. I discovered its circumference in the center would be so great that I would not be able to move it through the door of the shop when I had completed it!

"I decided to build it in the hallway adjacent to the shop, but at the same time I wrote to the actor and suggested that he draw a full-size sketch of the barrel just as I had done, using the dimensions I had prepared. I had the barrel about half done when I received a telegram from him to reduce the height from six to five feet. It had not occurred to him, until he saw the dimensions drawn to scale, just how immense and unwieldy that barrel would have been."

Construction of a foot-juggling barrel involves a process that reverses the customary procedure in barrel making. The hoops are placed inside instead of outside the barrel. There are fifty-five basswood staves, held together with 650 tiny nails. The barrel is covered inside and out with canvas, glued to the surface to reduce the hazard of breakage. The completed barrel weighs only one third as much as an ordinary barrel of the same size.

Scarcely a week passes without Van Wyck being called upon to make some piece of equipment entirely different from anything he has made before. A German cannon-ball juggler broke a steel ball, made for him in the Krupp munitions works, soon after arriving in New York for an American tour. So he gathered up the pieces, shipped them to Van Wyck, and instructed him to duplicate the ball.

Before the cannon ball had been completed, Van Wyck received a telegram from Hollywood asking him to make six sets of tiny wooden shoes for a troupe of dancing monkeys appearing in a motion picture. And a few days later, a man brought a trained dog to the shop and explained that he wanted a small metal cup in which the dog could put its four feet, the base to be heavy enough that the canine might maintain its balance in such a position.



In this small Cincinnati workshop, Van Wyck turns out his unusual equipment. The rigging on the floor will play its part in a circus thriller by supporting two women hanging by their teeth. Note the full-size sketch drawn on the floor

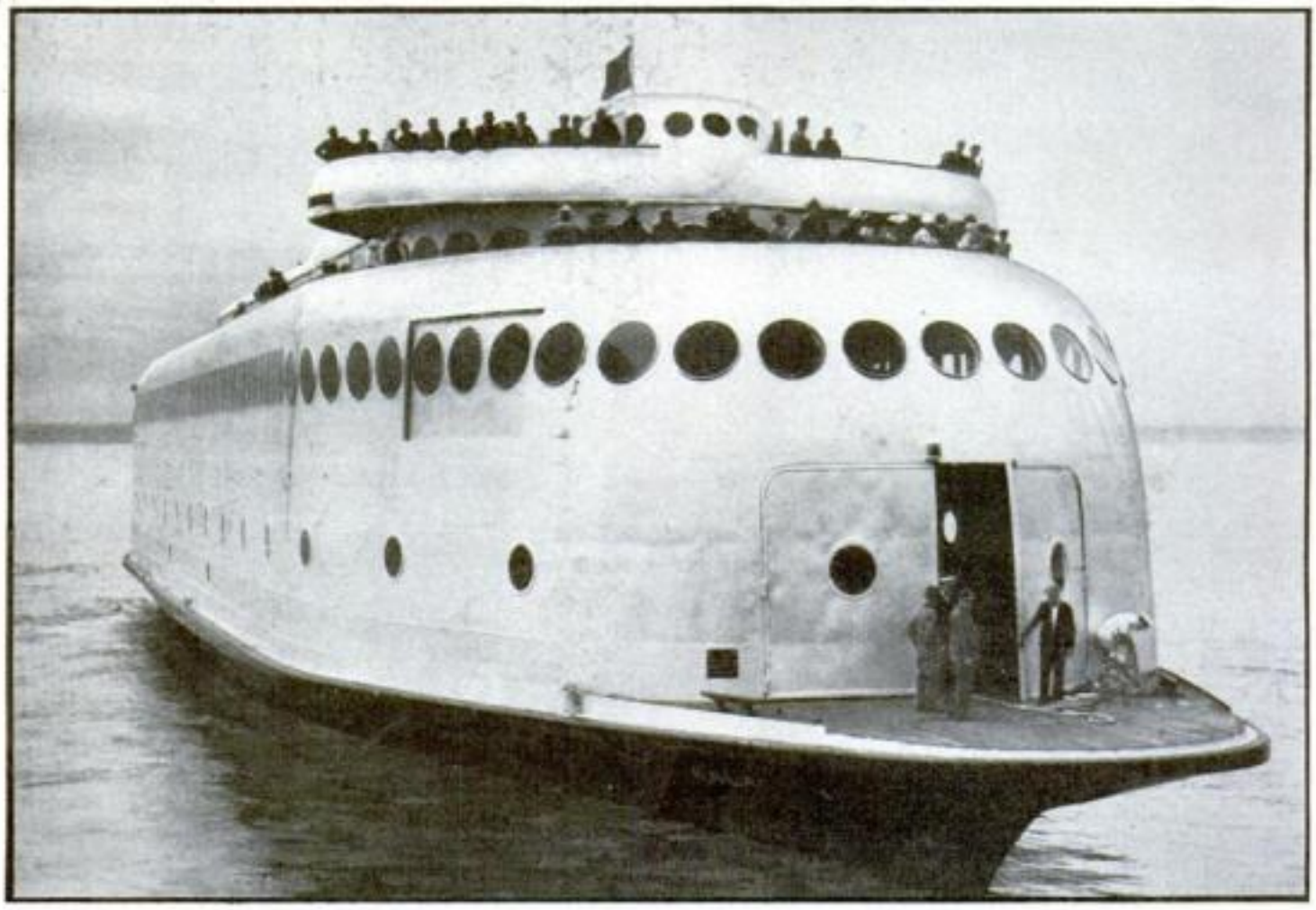
All of these are commonplace tasks for the circus technician. But there are intricate problems that challenge his inventive genius and mechanical ingenuity. Circuses frequently devise something new in aerial rigging—and expect him to provide it.

It was Van Wyck who designed the loop-the-loop trapeze, now a feature of many circuses. An ordinary trapeze bar is attached to the supporting crane bar with rigid, steel-tubing uprights as substitutes for rope. The joints are made with double ball bearings in brass housings. The performer stands on the trapeze bar, swings backward and forward to obtain enough momentum to revolve swiftly around the crane bar, and the result is a thrilling aerial spectacle.

Once a circus girl, learning to propel and control the revolutions of a loop-the-loop trapeze, fell from the top of the tent and was killed. Her feet had slipped from the bar and her hands had lost their grip. So Van Wyck set about to provide a safety device against such accidents. The result was a pair of keys to be attached to the soles of the performer's shoes. When he mounts the trapeze, the keys slip into slots in the trapeze bar and lock so that there is little possibility of a fall.

The safety of circus performers has been as much Van Wyck's concern as the making of intricate equipment on which the dare-devils risk their lives. He introduced the use of steel tubing for the framework and uprights of horizontal bars, flying-return rigging, high-diving towers, and various other paraphernalia, replacing the more cumbersome *(Continued on page 114)*

Ferry Is World's Largest Streamline Vessel



The motor ferry *Kalakala*, recently put into service to carry passengers and automobiles across Puget Sound.

DECLARED to be the world's largest fully streamline vessel, the speedy motor ferry *Kalakala* recently went into service to carry passengers and vehicles between Seattle and Bremerton, Wash. A welded shell of steel with rounded contours, designed to minimize wind resistance, gives the craft a striking outline. Its bridge resembles the wings of an airplane, and the shell tapers down to the water level at the stern, giving the boat a profile like that of a streamline automobile. The 3,000-horsepower vessel measures 276 feet in length with 55½-foot beam, and can carry 2,000 passengers and 110 cars. Its eighteen-knot speed enables it to cross Puget Sound in forty-five minutes. The name of the ferry is an Indian word meaning "flying bird."

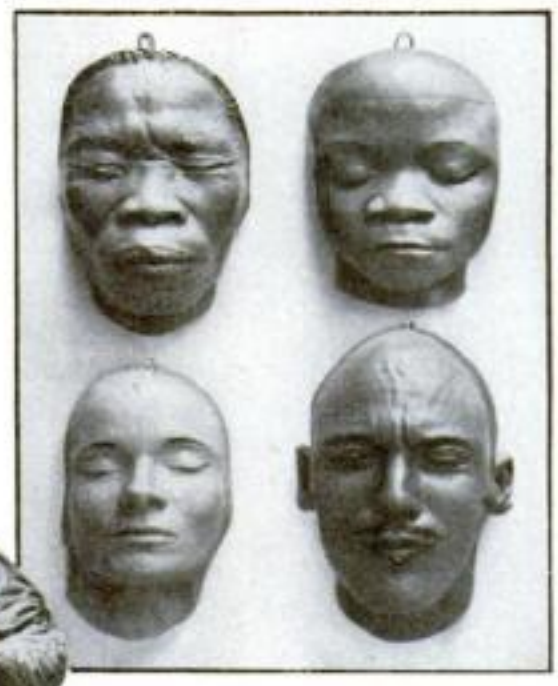
RIDGED GASKETS SEAL EASILY

GASKETS of a new type are said to give a tight seal with a fraction of the bolt pressure ordinarily required. Ridges on the surface of the gasket form a crisscross pattern which, because of the reduced contact area, is more easily indented than the usual flat surface. The gaskets are available in metals and metallized asbestos.

Below, a can of the new solid fuel which did not ignite when an incendiary bullet struck it

MAKES MASKS OF AFRICAN NATIVES

LIFE MASKS of African natives, made by Prof. Lidio Cipriani, Italian anthropologist, during a recent expedition to the Dark Continent, now afford stay-at-home scientists an opportunity to study the features of Bushmen and Pygmies. A process devised by Professor Cipriani made it possible to shape each plaster mask in only five minutes' time, and his only difficulty was to persuade his superstitious subjects that no evil spell would be placed upon them.

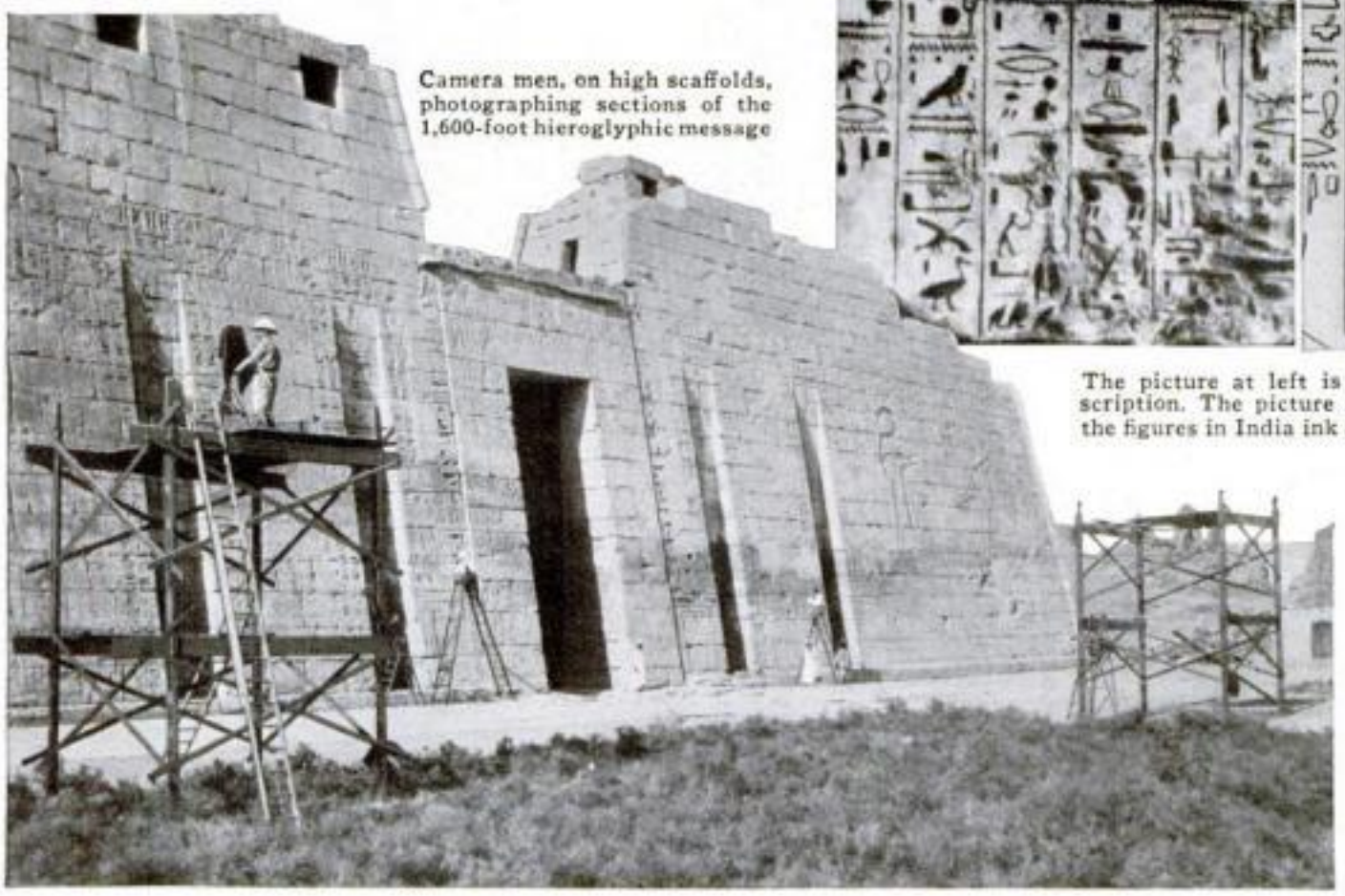


Life masks of African natives, showing tribal characteristics. At left, Prof. Cipriani and assistant taking an impression

TEST FIREPROOF GASOLINE FOR USE IN AIRPLANES

SEEKING a pure dry-cleaning fluid, a New York chemist stumbled by accident upon a process that makes ordinary gasoline virtually fireproof. The result of his discovery, demonstrated recently at New York University, is a reddish jellylike fuel for aircraft that may remove the hazard of accidental fire, although it can be employed in a motor with marked efficiency. To use it, heat from the airplane exhaust is applied to the fuel chamber and the resulting vapor is conveyed to the cylinders. The solid fuel, which can be made from ordinary gasoline in one hour, can be stored without evaporation or risk of explosion. In recent tests, it failed to ignite even when incendiary bullets were fired through cans containing the jelly.

CAMERAS HELP EXPERTS DECIPHER ANCIENT EGYPTIAN MESSAGE FOUND ON TEMPLE WALL



Camera men, on high scaffolds, photographing sections of the 1,600-foot hieroglyphic message

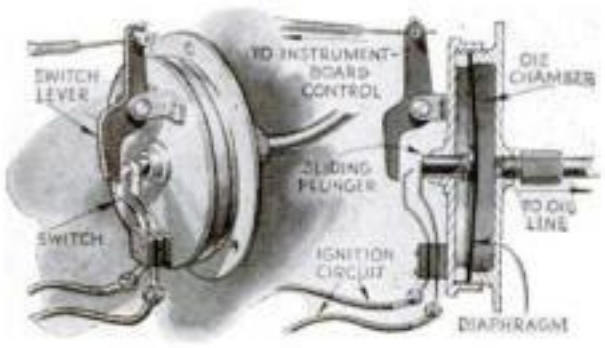
The picture at left is a typical photograph of wall inscription. The picture at right was obtained by marking the figures in India ink and then bleaching out the original

RECORDING and deciphering a message in closely packed Egyptian hieroglyphics, covering the entire side of a temple wall nearly a third of a mile long, is the monumental task just completed by experts of the University of Chicago's Oriental Institute after ten years of work. The 1,600-foot "billboard" at Thebes, on the Nile, was used by Rameses III, ruler of Egypt in the twelfth century B. C., to advertise his prowess in war. Its translation is declared to yield a mass of new knowledge about one of the most glamorous periods in Egyptian history.

To preserve the fast-disintegrating inscriptions, the experts developed a technique new to archaeological science. First they divided the wall, for convenience, into a series of rectangles. From lofty perches on wooden scaffolding, camera men then photographed each rectangle. The resulting pictures were enlarged on waterproof paper, capable of receiving a drawing in India ink.

Fastening one of these photographs to a drawing board, a draftsman mounted a ladder or was hoisted in a swinging seat to the corresponding section. Scanning the wall minutely, he added everything that he could see to the photograph, looking especially for lines that the camera failed to catch. Lines of the photograph and the draftsman's penciled additions were then traced in ink, and the photograph was bleached out in a chemical bath, leaving an ink drawing. Still more checks of the drawing were then made against the wall, by experts in hieroglyphics, before it was accepted as correct. The same painstaking technique was carried out for each section, despite the handicaps of the hot climate.

Translated, the records describe Rameses' exploits in four military campaigns, and his combats with wild sea rovers, whose invasion of the Nile delta region marks the entry of European peoples on the stage of recorded history. One relief depicts the world's first naval battle on salt water, in 1194 B. C. In another conflict, Rameses explains that he caused 12,000 of the enemy to be slain "for a remembrance of Egypt." Three huge folio volumes of plates picturing the inscriptions have already been published.



AUTO DEVICE SAFEGUARDS MOTOR AND BATTERY

SHOULD a car's oil supply fail, a simple new attachment automatically shuts off the motor and prevents costly damage to bearings and cylinders. The device also makes it impossible for a motorist to leave the ignition turned on when the motor is not running. It consists of an electric switch in the ignition circuit, operated by the flexible diaphragm of a chamber connected to the oil line. Proper oil pressure keeps the switch closed but if the pressure drops, the switch opens the ignition circuit and stops the motor. A hand control on the dashboard holds the switch closed in starting the car. The device is also suited to use on stationary engines.

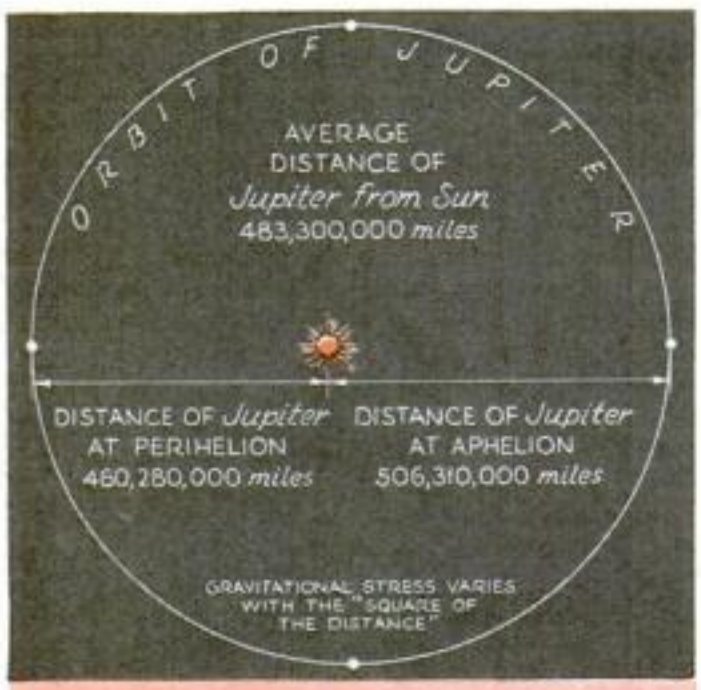
NEW GLASS MEETS SPECTACULAR TESTS

SPECTACULAR tests have been devised by a Toledo, Ohio, glass works to demonstrate the resistance of its new tempered glass to heat and abuse. Panes of the glass are bent, twisted, and pounded with a mallet, without breaking. Molten lead poured over a sheet of the glass that rests upon a cake of ice has no effect, although it instantly shatters ordinary glass. Under extreme stress, the tempered glass merely crumbles into harmless particles like rock candy due to a special process of casehardening. (P.S.M., Nov., '34, p. 18).

Used as a seesaw, this piece of tempered glass bends but does not break under the strain

A pane of tempered glass resting on ice resists the action of molten lead poured over it

Is *the Planet* JUPITER Our Solar System's



When Jupiter is nearest the sun (perihelion), its "stoking" effect is greatest; when farthest away (aphelion), this effect is at a minimum

A simple experiment with a sponge-rubber ball and a thermometer demonstrates a new theory to account for unusually hot summers occurring regularly

By
GAYLORD JOHNSON

OUR family of nine planets (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto) lives in the gigantic house of the solar system—with the sun as a central heating plant.

And, just as the warmth of an earthly apartment varies when the janitor stokes up the furnace, or fails to do so, so the heat sent out by the solar furnace varies. This variation in temperature has long been suspected because, in certain years, corresponding seasons were much warmer or colder on the average than in others. It has been only recently however, that the spurts and lags of the sun's temperature have been accurately measured.

The instrument which keeps tabs on the sun-furnace's heat output is called a pyrheliometer, or sun-heat measurer, and was invented by Dr. C. G. Abbott of the Smithsonian Institution in Washington, D. C.

The records which this instrument keeps of the variation in solar warmth (about three percent) reveal that the hottest periods occur about every ten to eleven years, and coincide roughly with the periods of greatest sun-spot activity. Since sun spots are enormous whirling storms which tear stupendous rents in the sun's surface, we may infer that the terrific boiling activity of the sun's interior during the period of sun-spot maximum accounts for the greater heat output at these times.

But what causes the increased inner activity about every eleven years? Why are the solar fires self-contained for a part of the eleven-year cycle, only to break out on the sun's surface, periodically in a heat rash of sun-spot storms? The answer to this question may have been furnished by a most ingenious theory, proposed recently by Edward Godfrey, engineer and astronomer, who lays the responsibility for the ups and downs in the temperature of the solar family's apartment to one of the tenants. In fact, he accuses the largest tenant of all, the planet Jupiter, with being the fickle "furnace man" who regulates the heat output.

Jupiter, according to Godfrey, has taken it upon himself, as the largest and strongest of the solar family, to stoke and control the sun's fires for the comfort, and sometimes discomfort, of all the other worlds in the system. He pokes the solar fires by merely going a few steps toward the furnace room! He has a system of re-

HOW FRICTION HEATS THE SUN

The effect produced by Jupiter's distortion of the sun can be demonstrated by rolling a sponge-rubber ball having a thermometer inserted as shown in the illustration. The temperature rises after a few minutes of rolling

Furnace Man?

TIDES OF FIRE

Jupiter's powerful attraction raises enormous tides upon the surface of the sun. The rotating sun works against this tidal "brake" and thus creates tremendous friction within its fiery mass. It is these opposing forces that intensify the sun's heat-producing activity

AN EXPERIMENT IN DISTORTION

A soft, sponge-rubber ball, compressed between two books and rolled, illustrates very simply how the attraction of Jupiter distorts the shape of the sun's rotating sphere

mote control, which operates through the mutual attraction of gravitation between himself and Old Sol.

This is how it works: Even though they are separated by an average distance of 483,300,000 miles, both Jupiter and the sun raise considerable tides upon each other's surfaces. Just as there are two constant daily tidal waves following the moon around our earth's oceans, so there are two tidal waves which follow Jupiter across the sun's oceans of liquid fire. (P. S. M., April, '34 p. 50).

Accordingly, during the rotation of the sun on its axis, which takes about twenty-six days, there is constantly a bulge of the surface toward Jupiter, and another in the direction away from the planet. And the sides of the solar globe are proportionately flattened. As you can see from the diagram, the effect is a perpetual distortion of the incandescent ball.

This distortion can be roughly imitated by holding a small, soft rubber ball tightly between two books and revolving the ball between the books. As the parallel books travel alternately back and forth, the two flattenings of the ball, rotating between them, travel completely around the yielding sphere of rubber. The friction of the rubber molecules upon each other creates considerable heat. It is easy to demonstrate, with an ordinary thermometer, the heat produced by this rolling action.

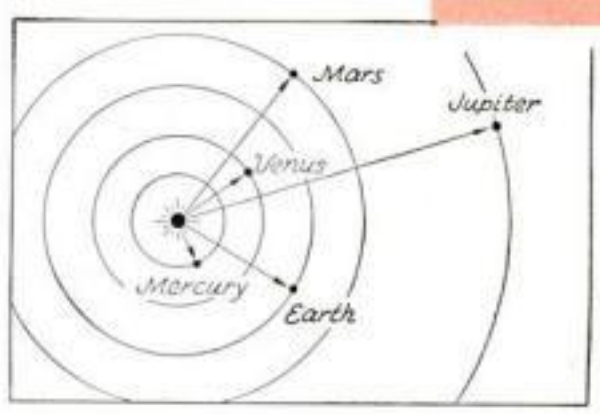
After you have done this, as I did, you will realize that a similar moving distortion of the sun's sphere, by the enormous gravitational forces produced by Jupiter, is bound to produce heat by the resulting friction of the sun's molecules upon each other.

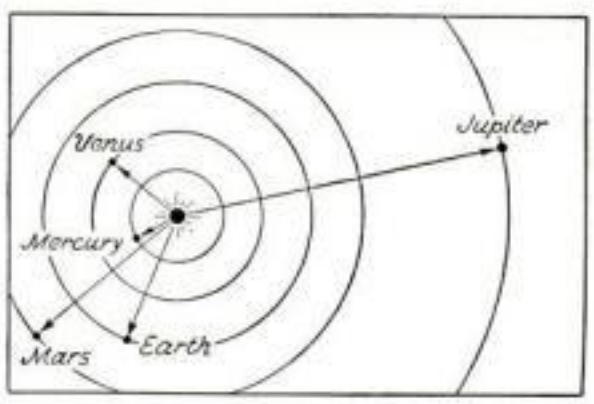
Secure a solid sponge-rubber ball about three inches in diameter. With a drill, or an ice pick, bore a hole through the spongy substance of the ball, straight to its center. Then remove the glass thermometer bulb and tube from any small, inexpensive thermometer. It is held to its scale only by two little bent strips of metal. When the glass is free, force it, bulb foremost, into the hole in the rubber ball. Try to have the quicksilver-filled bulb as near as possible to the ball's center.

Now you are ready to apply Jupiter's distorting gravitational forces to the plastic ball which represents the sun. To do this, put as much pressure as you can upon the ball's opposite sides with the books, or, better still, two bits of board. And as you press, rotate the ball between the boards. It is easier to apply the requisite pressure if you use only one small board in both hands and roll the ball upon a table top. A little care enables you to avoid breaking off the protruding thermometer tube.

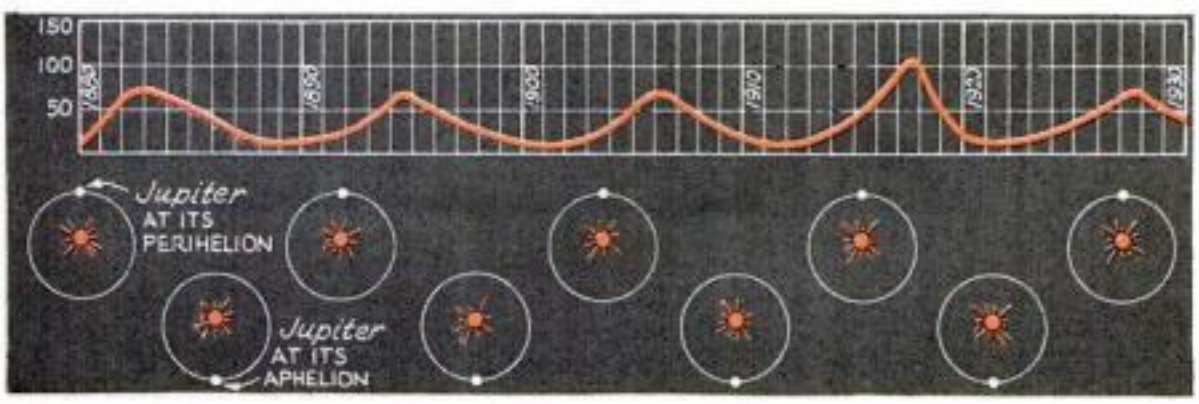
It is, of course, necessary to mark in some way the original height of the mercury in the thermometer tube which projects from the ball in order to measure the rise in temperature. A good way is to tie a white thread tightly around the tube and slip it up *(Continued on page 105)*

When the smaller planets are on the same side of the sun with Jupiter, they reënforce the gravity pull and the production of solar heat rises





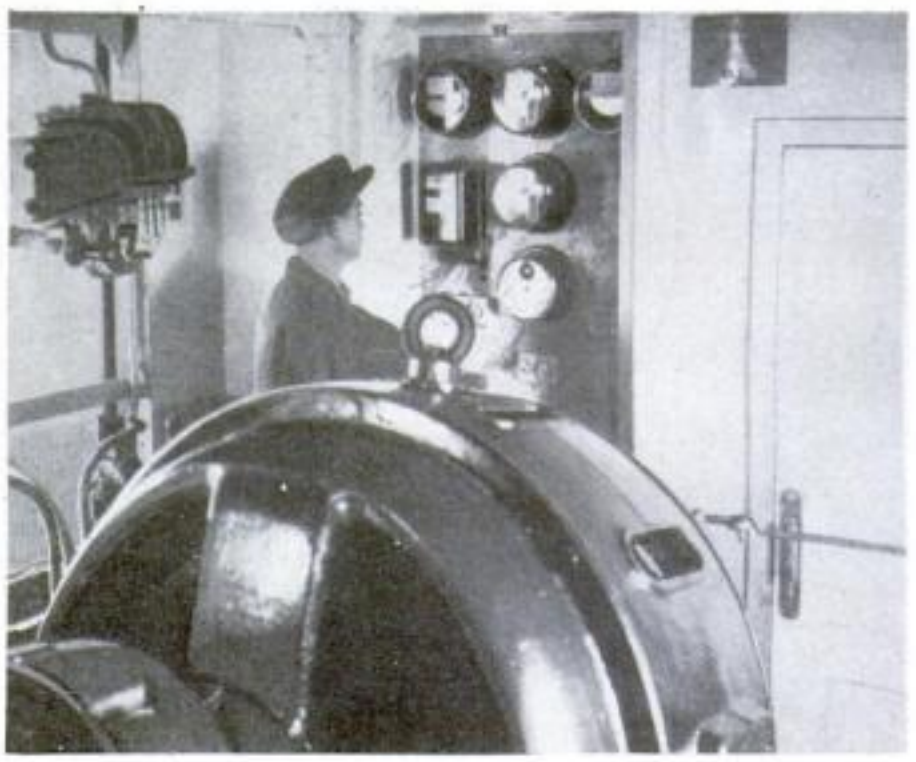
When the smaller planets are opposed to Jupiter, they partially neutralize that planet's effect and the creation of solar heat is less



The record of the fluctuations of the sun's heat (measured by the number of sun spots) over ten-year intervals coincides with the variations in the distance between Jupiter and the sun. The periods of peak heat production occurred when Jupiter was at a point nearest the sun and the reverse condition prevailed when Jupiter was most distant—an explanation for hot and cold summers

Huge Windmill Generates Electric Power

HARNESSING the wind for power has been a successful experiment in Crimea, Russia, where a giant windmill using a propeller of 100-foot diameter has shown itself capable of generating 100 kilowatts of electricity. The output supplements that of an adjacent steam-power plant. As soon as the breeze turns the windmill blades at the required velocity, a 220-volt generator within the machine room atop the eighty-foot tower is automatically cut in, and is cut out again when the wind dies down. Plans have been announced for a similar wind-power plant with ten times the output of the present one and eventually a network of such stations with a total capacity of 200,000 kilowatts is projected for the windy Crimean plateau.



Atop the high tower of a Russian wind-power station is housed this 100-kilowatt generator. It is driven by the giant 100-foot propeller, seen in the photo at the left. The unit is used to supplement a near-by steam plant

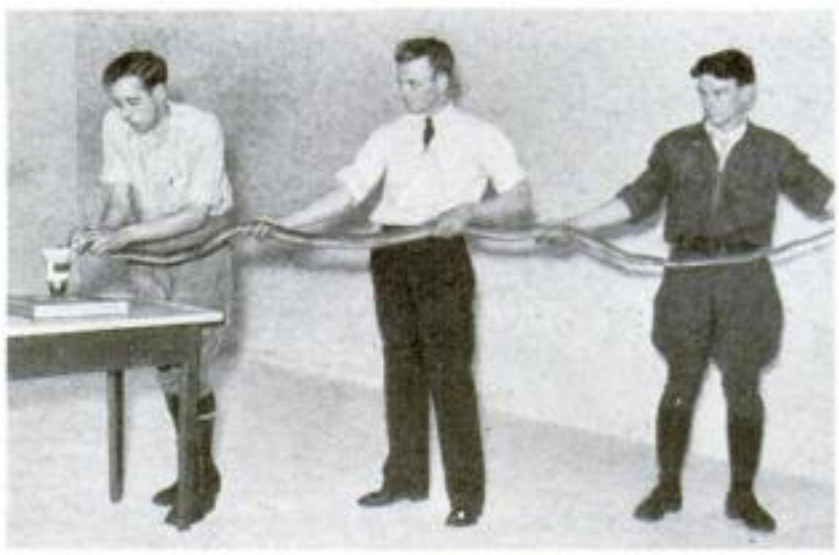
The great size of the propeller, 100 feet across, may be gauged by this close-up of one blade

ECHOES LOCATE FISH

ECHO sounders, used on shipboard to record ocean depth, may also prove valuable in locating schools of fish. In ordinary depth-finding, sound waves are directed at the ocean bottom which reflects them back to the ship. The time interval before their return shows the depth. A Norwegian survey vessel noting an interference in recent sounding work discovered the sound waves were reflected from the backs of a huge school of cod.

COBRA VENOM USED IN SERUM TESTS

WITH the recent discovery that the deadly venom of the cobra has hitherto unsuspected medicinal properties, a supply is now being obtained for trial in New York hospitals. The photograph at the right shows a giant king cobra at the Staten Island, N. Y., zoo, being forced to yield its poison for the experimenters. Tests made thus far indicate that a serum made from the snake venom has beneficial effects when administered to sufferers from narcotic addiction. The experiments have also shown that the venom has a limited therapeutic value in the treatment of a certain form of cancer which had been induced clinically in rats by inoculation during the laboratory tests.



A large king cobra, at the Staten Island Zoo, is made to yield a quantity of its deadly venom for use in experimental serum studies

NOVEL SIDELESS GOLF BAG CAN BE WHEELED ABOUT

TO AID in carrying his own clubs about a course, a fourteen-year-old golfer of Brighton, N. Y., has designed a lightweight golf bag devoid of sides and equipped with a ball-bearing wheel. Easily trundled about, the bag may also be set upright upon a retractable steel spike. A box attached to the light wooden framework carries five balls, which are released by pushing aside a spring clip, as shown above. Places are also provided for pencil, tees, and other incidentals.

The Man with the Net

INK *made from mushrooms is being used to foil forgers. If a signature is suspected, the ink is examined for mushroom spores. If it contains none, the signature is known to be spurious.*

DENVER, COLO., *has an official elevation of one mile, to the foot, above sea level.*

SEA HORSES, *like kangaroos, carry their young in pouches.*

BEES *with what is said to be the highest hive in the world live on a terrace of Rockefeller Center, eleven stories above Fifth Avenue, in New York City.*

YOUR CHANCE *of being killed in an automobile accident this year is one in 3,500, of being injured, one in 100.*

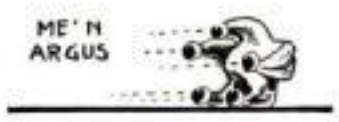
COCONUT SHELLS *filled with explosives were used as bombs in a Hawaiian revolution.*

AVERAGE DISTANCE *between airplane landing fields in the United States is thirteen and a half miles.*

DISCARDED *automobile brake drums form the chimes of the First Baptist Church in Addison, N. Y.*

ONIONS *give off rays which are reported to be beneficial in treating nasal catarrh.*

STARFISH *have an eye at the end of each arm which can detect light too faint for the human eye to see.*



A MODERN LINER *presents an area of as much as three acres to side winds.*

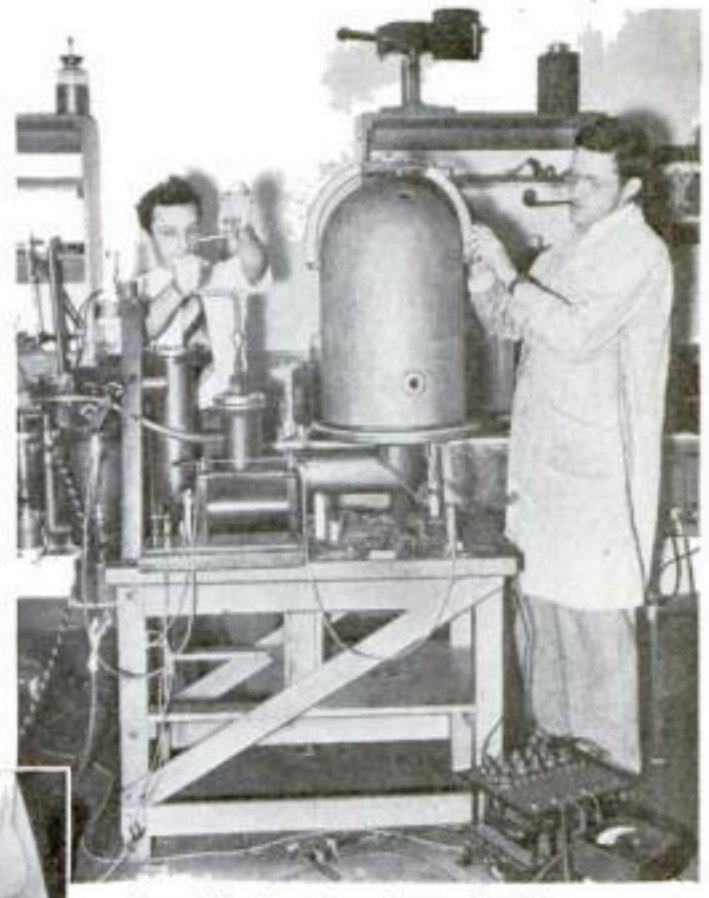
PETRIFIED TREES *containing gold embedded in their trunks have been found in Nevada.*

SIX MILLION GERMS *have been found on a single house fly by microscopic examination.*

LEMONADE *was a favorite drink in China 700 years ago.*

TELESCOPE MIRRORS SHAPED QUICKLY

GREAT telescope mirrors may soon be shaped to the required curvature in minutes or hours, instead of years, through a newly announced metallizing process. In the traditional method, the glass mirror must be ground to an exact parabolic curve —an operation of such delicacy that it took three men five years to grind the 100-inch mirror of the Mt. Wilson Observatory in California—before the silvering or the newer-style reflecting coating of aluminum is applied. The latest process, successfully tried out on a twelve-inch disk, the other day, at Pasadena, Calif., dispenses entirely with grinding and builds up the desired curvature out of the finishing coat of aluminum itself. If anything goes wrong, it is necessary only to remove the aluminum and repeat the process. The aluminum, evaporated from heated electrodes, is deposited on the glass in a vacuum jar. While the mirror in its mounting is slowly revolved, by a U-shaped electromagnet outside the jar, a brass screen with an opening of question-mark shape distributes the aluminum in the exact mathematical proportion to produce the parabolic curve. Mirrors of hyperbolic and other complex shapes, almost impossible to grind, may be prepared by the new process.



Jar, inclosing mirror, is revolved by a magnet

Brass screen with aperture which distributes aluminum, and an experimental glass disk

FILMS INCUBATION OF A TURTLE EGG

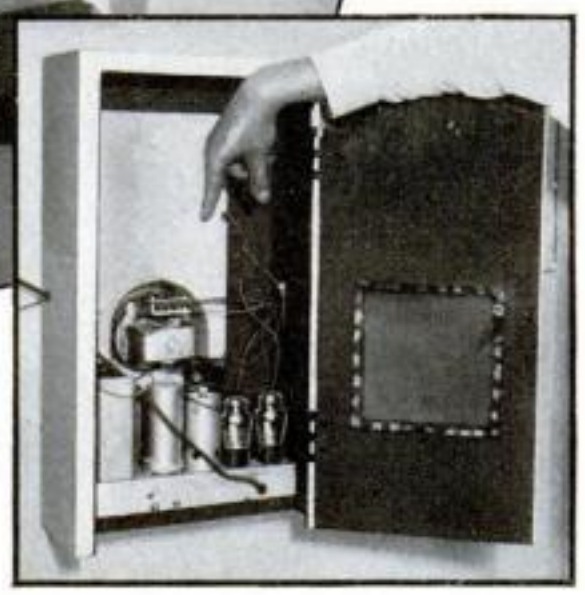
WHAT goes on inside a turtle egg, before a turtle hatches, has been filmed at the American Museum of Natural History to produce a movie of unique scientific interest. By fitting a small window in the side of an egg and arranging a mirror to project a magnified, eight-inch image of the contents, Dr. G. K. Noble, curator, obtained pictures of the living turtle embryo in all its stages. Development of the eyes and other organs, and even the heartbeats, were clearly visible in the finished film, which is expected to prove of exceptional interest to students of biology. The experiment was made possible by the fact that turtle eggs incubate at approximately the temperature of the average room, obviating the need of keeping them in a special incubator which would have made motion-picture photography difficult.

A turtle egg, fitted with a transparent window, being placed under the lights so that a magnified image will appear on the screen above. At right, a close-up of the egg, showing the embryo turtle at one stage of growth

WALL RADIO SET GIVES IMPROVED TONE

Loudspeaker and control knobs of built-in radio set. The slits in the front of the cabinet allow air waves to escape from the receiver

BUILT-IN radio receivers, recently introduced, are installed directly in the walls of homes. The wall itself serves as a sounding board, improving the tone quality and also the realism of the program, because of the non-directional effect. Slits in the front of the radio cabinet and an aperture in the opposing wall allow air waves within the receiver to escape, avoiding undesirable back pressure.



Back view of set. The loudspeaker is countersunk into the wall, which serves as a sounding board

SEEKS INVISIBLE FISH WITH BLACK LIGHT

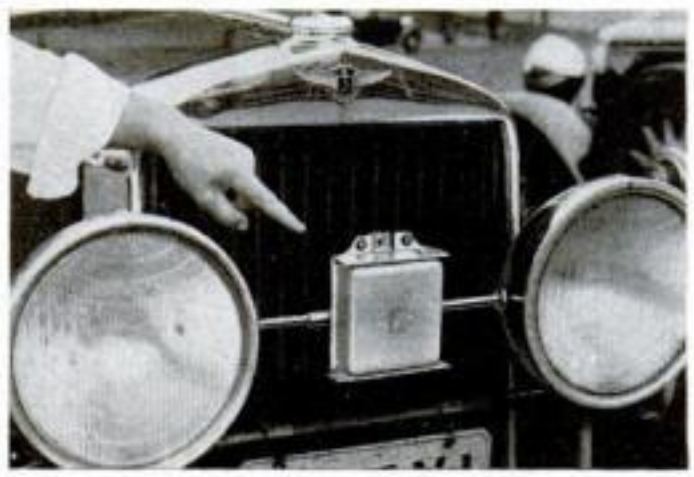
DO "INVISIBLE" FISH, colored in hues beyond the range of the spectrum visible to human eyes, inhabit the lightless depths of the ocean 2,000 feet or more below the surface? To find out, Dr. William Beebe, noted explorer, plans to take with him an ultra-violet-ray projector on his next descent in the diving globe that he has used in deep-sea explorations off Bermuda. Shown above, the projector will direct a beam of "black light" through a quartz porthole, causing responsive marine life that comes within its range to glow or fluoresce brilliantly.

MACHINE REVEALS HEART AS DYNAMO

MINUTE electric currents, generated in the human body by the beating of the heart, are made visible by an electrocardiograph recently placed on public exhibition at the Franklin Institute, Philadelphia, Pa. Wires lead from the apparatus to a pair of cups, attached to the arms of a chair and containing an electrically conductive solution of brine. When the hands are dipped in these cups, as illustrated at right, contact is made with the registering apparatus, and the visitor may see the feeble heart currents amplified and made visible in the form of a pulsing shadow in a tube which forms part of the machine. The study of such currents, within recent years, has proved of incalculable value in medical diagnosis of many cardiac disorders.

BITS BORE DEEP WELLS

DESPITE their distorted appearance, bits of the odd shapes shown above are used to bore straight holes, serving to sink wells more than two miles deep. The bits range from three and three fourths inches to twenty-eight inches in diameter, and from thirty-two to 2,200 pounds in weight. The larger of the bits illustrated is used to start a deep hole, while the smaller one chops through rock 1,200 feet below the surface.



CAR GIVES WARNING WITH MUSICAL TONE

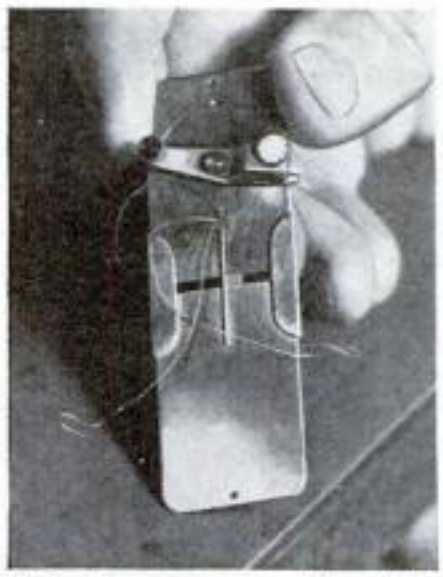
A NEW electric warning signal for automobiles, designed as a substitute for raucous horns, employs metal chimes. When the steering-wheel button is depressed, a powerful magnet actuates a hammer that strikes a pair of tone bars at the top and bottom of the housing, producing a melodious and plainly audible signal. The compact size of the new signal is shown in the photograph at the left.

Splicing Tool Aids in Study of Hairs and Fibers

FIGHTING gangsters and racketeers may be the unforeseen application of a tiny instrument perfected by a U. S. Department of Agriculture technologist. Because he wanted to study hairs and fibers from a commercial viewpoint, Dr. J. I. Hardy devised an improved tool to slice them into thin transverse sections for microscopic examination. Through its use, a specimen can be prepared in ten minutes, instead of several hours required by former methods. Moreover, the structural details of each fiber are preserved so clearly that identification is easy; not only is it possible to distinguish at a glance between hair, wool, fur, silk, or cotton, but a particular type of each may be recognized.

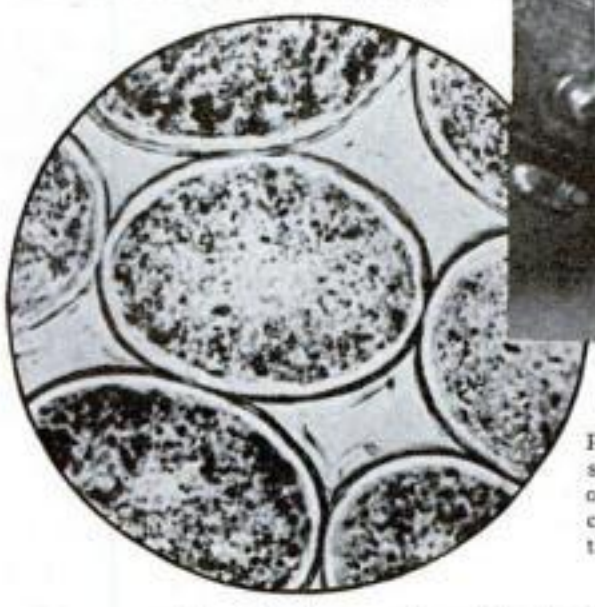
Department of Justice officials point out that a scientific detective, armed with the new method, might make rapid and valuable use of so small a clue as a fragment of hair found on a suspect's clothing or at the scene of a crime. A tuft of clothing fibers, such as a burglar might leave behind on a nail or splinter, might be compared with a suspect's garments and prove his presence at the place. In the field of commercial frauds, the invention provides a check on racketeers misrepresenting the quality and value of furs.

By means of a screw-controlled plunger, the three-inch instrument ejects a bundle of fibers, in perfect alignment, from a slot only eighty-five ten-thousandths of an inch wide. A drop of quick-drying cement "fixes" them so that they may be sliced off as thin as one ten-thousandth of an inch, without damaging their delicate structure. The resulting specimens differ widely.



This tiny instrument slices hairs and fibers into thin transverse sections for study under the microscope

Technician preparing a specimen of hair for examination. With the new tool, this process takes only ten minutes



Photomicrograph at left shows typical specimens of human hair. The oval cross sections indicate that the hair was curly

MODEL STATION ACTUALLY BROADCASTS

OPERATING on less power than it takes to run an automobile tail light, the world's smallest broadcasting station, nicknamed "WEE," has been placed on exhibition by a radio manufacturer. A six-inch working model of a stand microphone, in a miniature studio, may be used as a hand type and is put in operation by throwing a switch on a realistic panel. Midget transformers and coils put the program on the air. The model station has a transmitting range of 200 feet.

The world's smallest broadcasting station, which operates with a transmitting range of 200 feet

USE NOVEL OBSERVATORY TO STUDY LIGHTNING

To STUDY lightning, General Electric engineers have just erected the unique observatory shown in the upper view, above. A periscope topped by a crystal ball enables an observer to watch flashes in all parts of the sky without turning his head. Meanwhile, a twelve-lens camera, shown in the lower view, photographs the strokes. A continuous blast of compressed air from a ring of perforated pipe keeps rain away from the lenses during a storm.

Microscopic

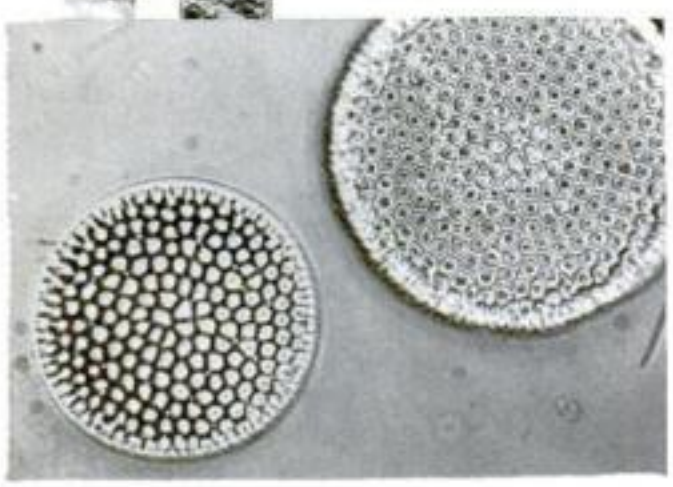
OFFER RARE BEAUTIES TO

The green scum found on bird baths is a source of interesting microscopic plants. It can be easily scraped off with a knife. Under the microscope, right, the plants are revealed as green, ball-shaped algae

A black embedding material, developed in Germany, makes algae stand out more distinctly under the microscope. Here a drop is being placed on the cover glass prior to mounting

SIMPLESPECIMENWASHER

"Fixed" algae may be washed in a cheesecloth-covered tumbler. A flow of water is supplied through a glass tube extending to the bottom of the glass. At the left are Spirogyrae, magnified 100 times



Photomicrograph of diatoms magnified about 475 times

SEVERAL weeks ago, I bought a bird bath, an earthenware affair colored dark green. There was a sunny corner near the lily pool that seemed to have been created for it. The basin of the bath is emptied every day, rinsed out, and filled with fresh water. One day I noticed that, instead of the usual dark green, the basin was lighter in color where the water stood, as if some one had sprayed a thin coating of light green paint over it. Or was the original color fading? Each day the green became brighter.

Close examination revealed that the paint had not done a chameleon act, but that the bottom of the basin was covered with a slippery, brilliant green scum. What was it? The naked eye could not discern. Here was a chance for that new microscope objective lens to prove its worth!

It required but a minute to scrape a little of the green deposit off the basin with a knife, transfer it with a medicine dropper to a one- by three-inch glass slide, and drop over it a No. 2 cover glass (twenty-two millimeters square).

A bit of adjusting at low magnification, and there appeared in the microscope field a shapeless maze of green material. After I had looked at it for a minute or so, it began to take some semblance of form. Here and there could be distinguished masses of little green balls. So I switched to a higher power, 575 diameters to be exact. Surprising what a tenfold increase in magnification will do!

The green balls were very distinct now. Some were clustered in little groups of four. Here and there were pairs of them, flattened along the lines of contact. Scattered about were single, round ones. In addition to the balls were assorted filaments, bits of shapeless tissue, and one or two microscopic animals scurrying about among the green plants.

A textbook of botany soon cleared up the mystery. The green balls were what the botanist calls *Pleurococcus vulgaris*, a non-moving form of one-celled, green algae. The little groups of two, four, and more were formed by divisions of single cells to produce new individual plants, a common method of reproduction. Pleurococci can be found on stones, shady sides of old tree trunks, flowerpots, and the earth itself. Masses of the tiny cells have the appearance of splotches of green paint.

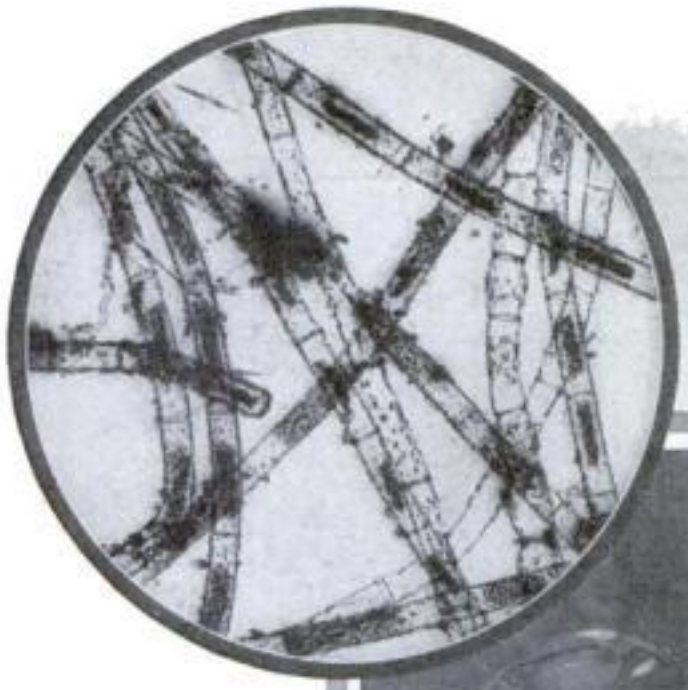
If, in that bird bath, there was growing such a beautiful, though simple, microscopic plant, what about the thousands of other algae to be found all over the

Endless Varieties of Algae, Always Within Easy Reach of Every One, Become Fascinating Subjects Under the Microscope's Lens

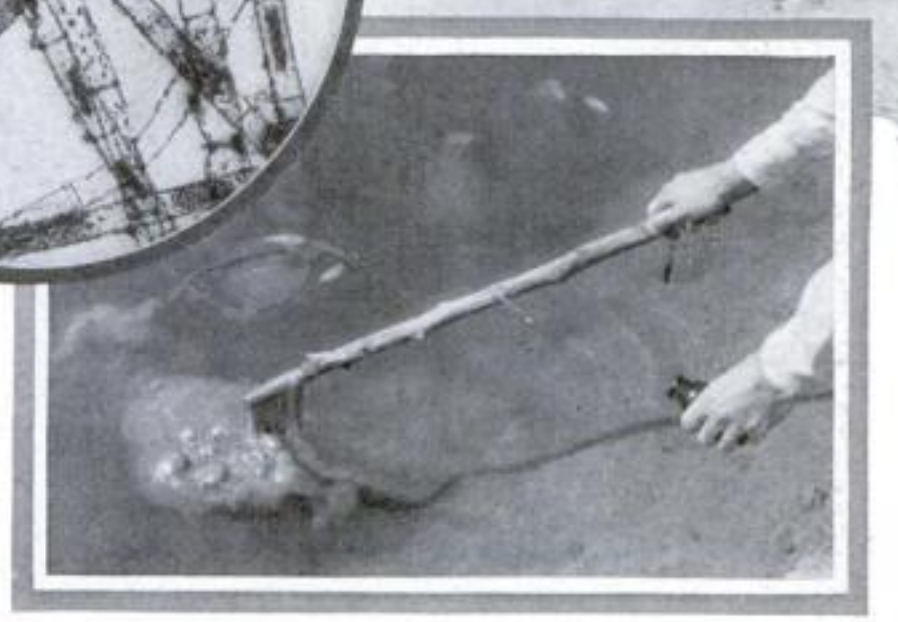
By MORTON C. WALLING

PLANTS

THE AMATEUR •



Filaments of algae as they appear under a magnification of 100 diameters. These algae were taken from a scum patch, floating on a lake as shown at the right. Such specimens are easily collected



An ordinary fine-mesh net, such as is used in handling tropical fish, is excellent for collecting specimens from pools or streams

world? The botany book had said that there are some 9,000 or 10,000 known species of these tiny plants, to say nothing of the ones that haven't been identified. They grow wherever there is enough moisture and light to permit them to manufacture food—in ponds, lakes, rivers, ditches, stagnant pools, swamps, on moist rocks, even in hot springs!

So an expedition in search of such fairy-like plants, whose beauties can be seen only through the microscope, seemed in order. An empty petroleum-jelly jar with screw lid, a few two-ounce bottles with wide mouths and cork stoppers, a foot-long piece of glass tubing, and a small net of the type sold for handling tropical fish in home aquariums, comprised the collecting outfit.

A short drive brought the field expedition to a small creek gurgling along a rocky bed. Flanking the main channel were relatively still pools of water, in some of which were patches of bright green, even more brilliant than the one in the bird-bath basin. The water was four or five inches deep, but with the aid of the glass tubing it was a simple matter to gather some of the green material without stirring up a lot of mud. The glass was used first to loosen the green growth—which turned out to be mostly Spirogyra, one of the commonest and most beautiful algal forms—and then as a dipping tube to raise the material to the surface and deposit it in a bottle, half filled with water. The use of the dipping tube was described in last month's issue.

The fish net, made of cloth similar to window-curtain material, proved to be a serviceable tool for gathering small, free-floating masses of algae, and even for capturing individual cells, microscopic in size. The net would have been better, however, if an opening had been made in the bottom and a small, glass phial inserted and held by a rubber band. With such an arrangement, commonly used by collectors, the collected material is washed from the net into the phial, by swishing the net through the water. You will be surprised at the things you capture in this way in addition to algae.

After collecting some mud from the bottom of the puddles at the edge of the creek, the expedition moved on. More creeks; roadside ditches; a tropical-fish hatchery where masses of algae were growing in the breeding tanks—all yielded additional material. Floating in a small lake were masses of hairlike strands, held up by imprisoned bubbles. A bit of one of these was pulled in with a stick, and bottled.

But it was at the microscope that the real exploring began. This experience proved even more thrilling than the field expedition. Under the magic of the lenses, the scummy masses in the bottles became fairyland plants, whose beauty must be seen to be appreciated. It was a simple matter to mount bits of the algae on a slide, with water as a medium.

Examination of the several different kinds of algae showed that they all have much in common. They are made up of distinct cells. Even the filamentous kinds, which grow in long threads, sometimes branched, seem to be nothing more than a lot of individual cells joined together. They can be broken up into single cells and still live. Some of the specimens were seen to consist of threads made up of live, green cells and dead, empty cells, haphazardly strung together. The dead cells probably were emptied by microscopic animals which believe in vegetarian diets.

The grown-up algal cell, which is a perfect example of a plant cell, is incased in a membrane, made usually of cellulose. Next within the membrane is the protoplasm containing various objects such as vacuoles and chromatophores or color-containing bodies. In the center is the cell nucleus.

The chromatophores of some cells contribute more than any other part to the beauty of the plant. They may be shaped like plates, stars, spirals, strings of beads, or disks. Some are arranged in regular order, others like microscopic nets, and still others with seemingly no attempt at order. In some forms of algae are dense bodies lying within the chromatophores. These are called pyrenoids and have been found to contain albumen and to be surrounded by starch. They apparently are storehouses of reserve material.

If you know your Greek, the "chromato" part of the word chromatophore will suggest that that part of the algal cell contains color. This fact is easily verified with the microscope. The color, however, is not always green. There is a large family known as the blue-green algae. Such colors as brown, red, purplish green, and yellow are common.

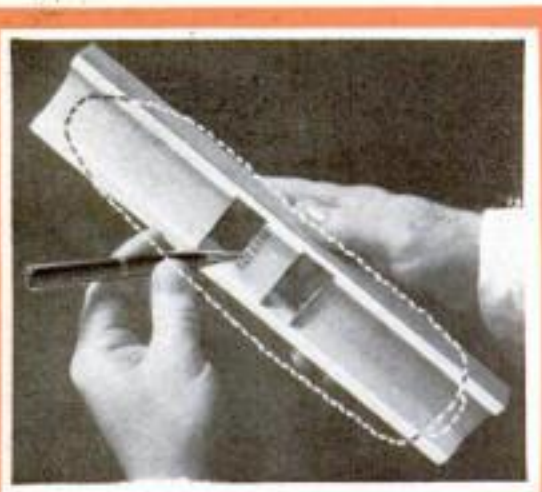
Rocklike deposits around some of the hot springs in Yellowstone Park owe their pink, blue, blue-green, orange-red, and yellow colors *(Continued on page 94)*

Handy Aids *for the* HOMEMAKER

GRINDER REPLACES GARBAGE CAN Driven by an electric motor, the device illustrated above reduces waste foods to a fine pulp which washes down the drain without obstructing it. Everything from watermelon rind to soup bones can be shredded or macerated, the only exceptions being bottles and tin cans. Grease is said to coagulate and pass through without clogging

REFRIGERATOR SPACE SAVER

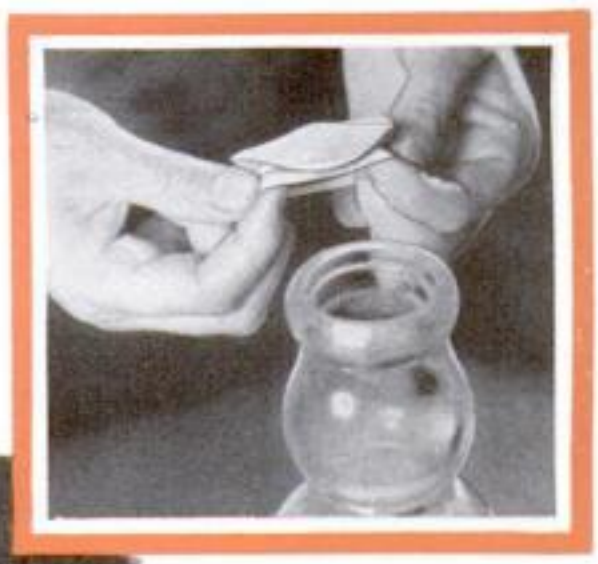
A set of glass food jars that slide around in an oval tray, is the latest refrigerator convenience. With a touch of her finger, the housewife causes the jars to move, making the selection of food quick and simple



STAND SUPPORTS ELECTRIC FAN

Resembling a floor lamp, the electric fan at the right can be placed in any part of the room. The stand is adjustable from thirty-six to sixty-five inches in height

GRATER TAKES CORN FROM COB. With a new kitchen accessory, the task of removing green corn from the cob is made easy. The ear of corn is held in the position shown by dotted lines. The pencil points to the ridged grating blades

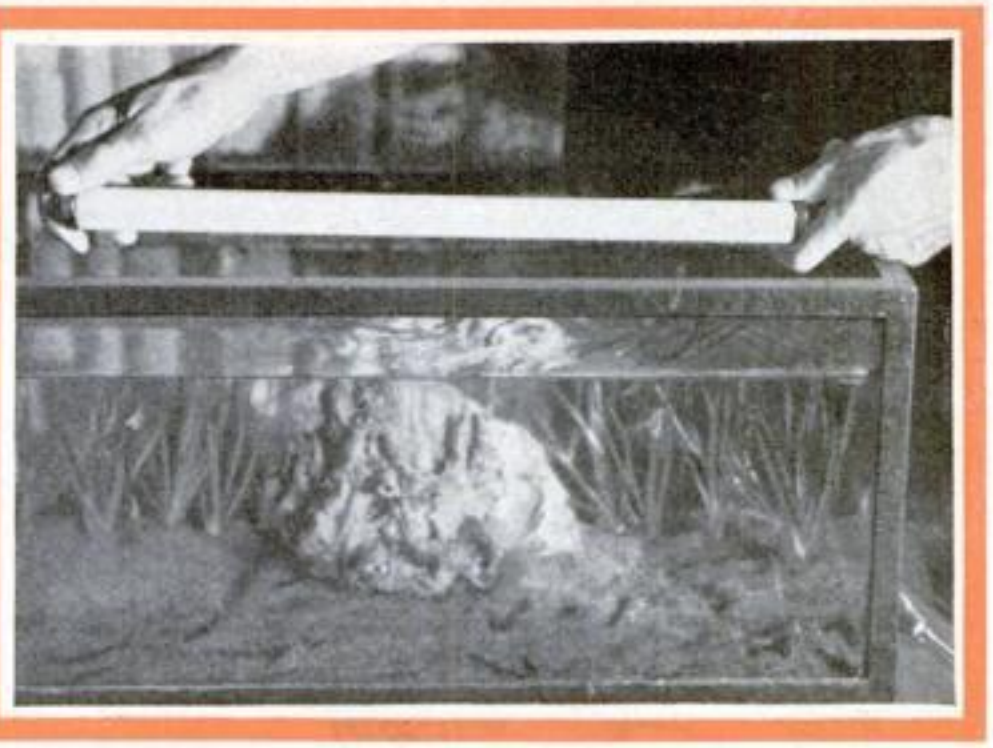


INCENSE STICKS ARE STRUCK LIKE MATCHES
Intended for destroying undesirable odors in the home, a new type of incense stick is ignited like a match by rubbing the head on a rough surface. While burning, it may be held in the hand or propped in a hole in the box, as illustrated. Various scents, such as violet, are available

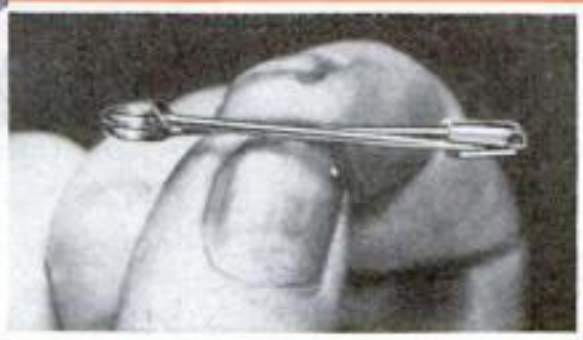
SANITARY MILK-BOTTLE TOP RESEMBLES A BATHING CAP

Slipped over the mouth of any milk bottle, a new rubber hood provides an air-tight cover and protects the lip of the bottle from dirt. Freezing of the milk does not break the seal, but merely pushes the elastic hood upward. After the bottle has been partially emptied, the hood can be replaced to protect the remaining milk. Intended for use by dairies, the covers can be produced cheaply

COLLAPSIBLE WHEELBARROW. Designed on the lines of a child's folding carriage, the novel wheelbarrow illustrated above is a boon **to amateur gardeners. The rotproof canvas bag holds leaves or cuttings, while a zinc-lined tray is handy for tools. The two wheels have rubber tires**

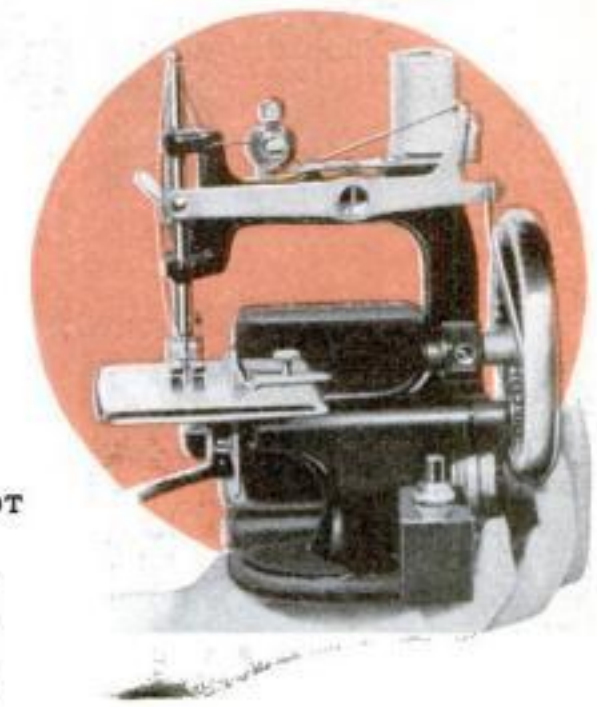


LIGHT FOR AQUARIUMS. Electrical connectors at both ends make it easy to mount a new eighteen-inch light designed for use in aquariums. It comes in five colors—blue, purple, green, yellow, and red—as well as in white, frosted, and clear. Interesting color effects can be secured by mounting several colors in an aquarium



SAFER SAFETY PIN CANNOT SPRING OPEN IN USE

Greater safety for the baby is provided by a safety pin that springs closed instead of open. A slight pressure locks the point inside the guard. Top photo above shows pin closed, lower photo pin locked. At left, the pin in use

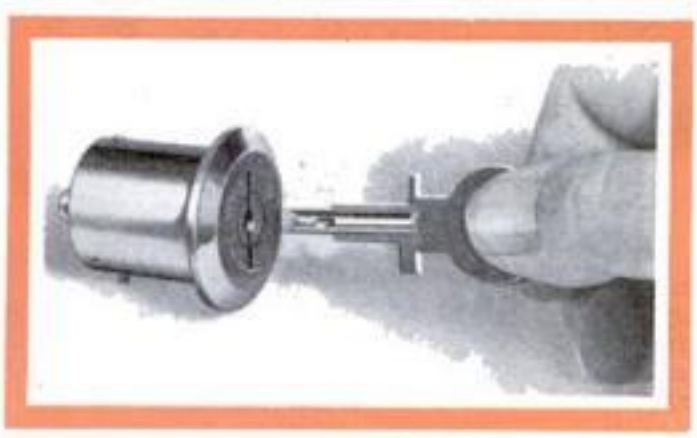


MIDGET SEWING MACHINE. Weighing only about five and a half pounds, the electric sewing machine illustrated above is convenient for travelers and for business or college women. It clamps to any table and is said to do almost anything that a machine of standard size will do

ELECTRIC TIME CONTROL FOR APPLIANCES

Persons who habitually fall asleep reading can be assured that the lights will be turned off at any hour specified, by the use of a new electric time control. This device will also turn the radio on or off automatically, or it can be used to control other electrical appliances for any interval up to twenty-four hours

PROTECTION AGAINST LOST KEYS. If a home owner loses one of the keys to the new lock shown below, he can forestall the use of the key by an unauthorized person. Pins and tumblers in the lock can be rearranged so that the lost key will not fit, and the other keys can be altered to suit the new combination



"LIPSTICK" SUEDE BRUSH. Smaller than a lipstick, this handy wire brush cleans suede shoes and also removes dirt from hats, handbags, and gloves. A metal cap covers the brush when it is not in use, to protect the handbag or pocket

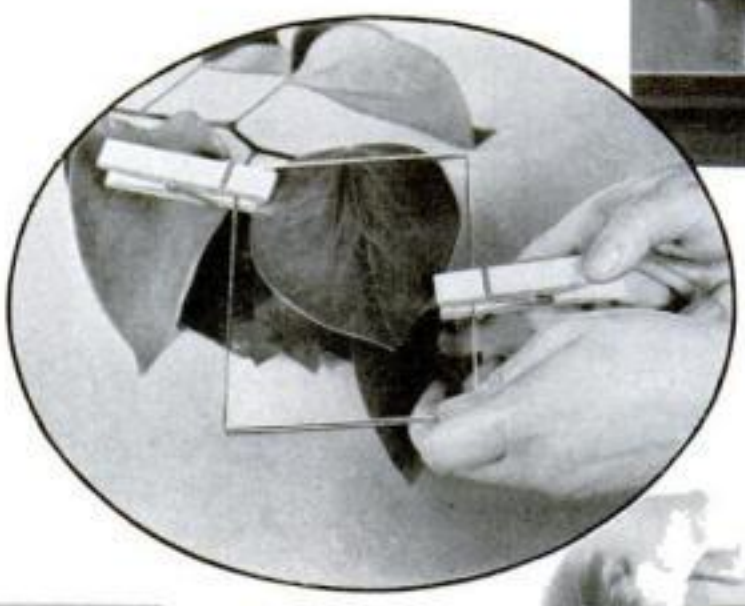
BOX HOLDS ALL MAIL

Magazines and small parcels, as well as letters, are accommodated by this mail box. The letter compartment tilts forward to make a rack for them

WONDERS OF
Plant Life
SHOWN BY
Simple Experiments

HOW LIQUIDS RISE IN PLANTS

The upward movement of water or sap in a plant can be shown by fitting an eye-dropper tube to the end of a cutting by means of a short piece of rubber tubing. Do this under water so the dropper will be filled. Place the tip of the dropper in a vial of water. The water level in the vial will go down as the liquid is drawn upward into the plant

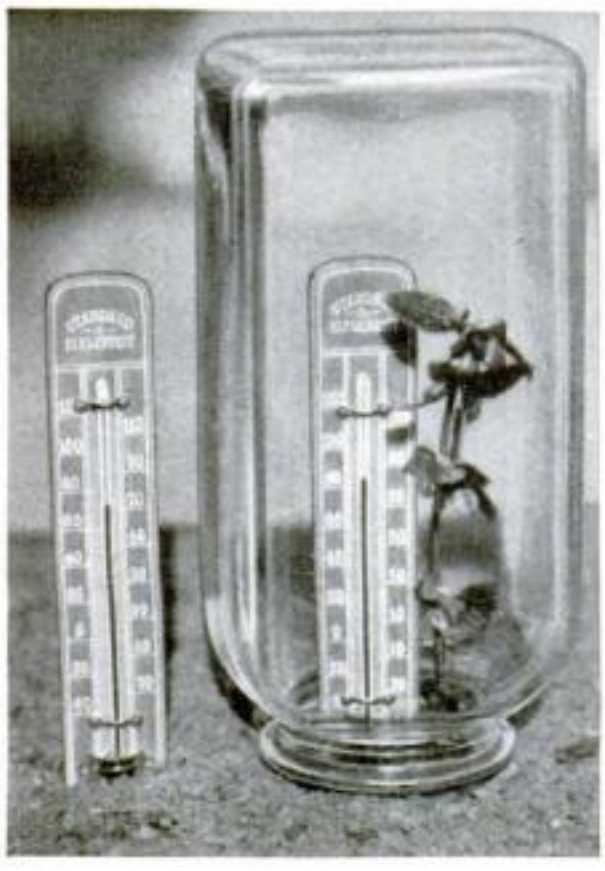


GREEN LEAVES GIVE OFF MOISTURE

Place a fresh leaf between two pieces of glass and clamp with spring clothespins. In an hour or two, one of the pieces of glass will be coated with moisture given off by the stomata, or breathing holes. These stomata are located on the underside of each leaf

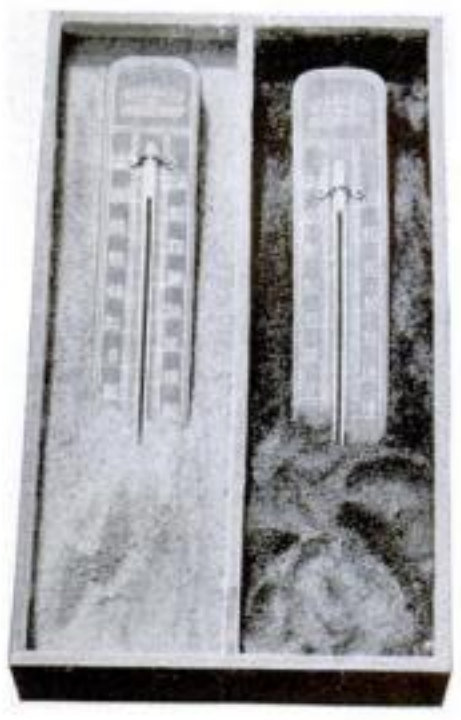
OSMOTIC PRESSURE IN PLANTS

To demonstrate the force which raises the sap in a plant, fill a hollowed-out carrot with sugar solution and fit it with a glass tube. As the carrot takes up water from a jar, the solution will be forced up the tube



TURNING TO LIGHT

How all plants turn toward the light may be shown by sowing mustard seeds in a pot and covering it with a cardboard cap in which a small window has been cut. Remove the cap each day and examine the plants to see how they seek the light



WHY USE GLASS JARS?

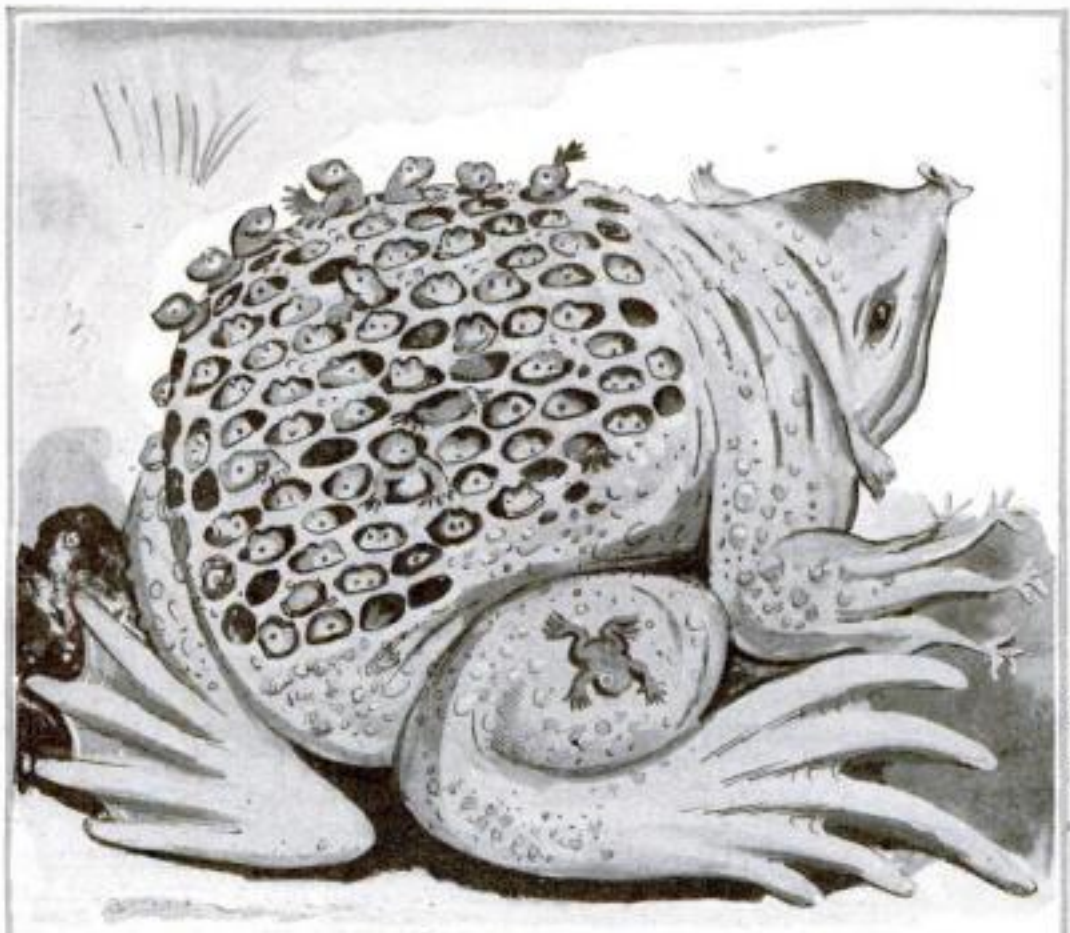
In growing roses and other plants from slips, an inverted glass jar is used to keep the plant warm. Its value is shown by placing a thermometer in a jar and another outside. The one inside shows a higher temperature when the sun is shining on both

DARK SOILS ARE WARMER

A dark soil absorbs sunlight and therefore is warmer than a light soil. In the experiment, one thermometer is covered with white sand, the other with sand and charcoal

Un-Natural History

By GUS MAGER



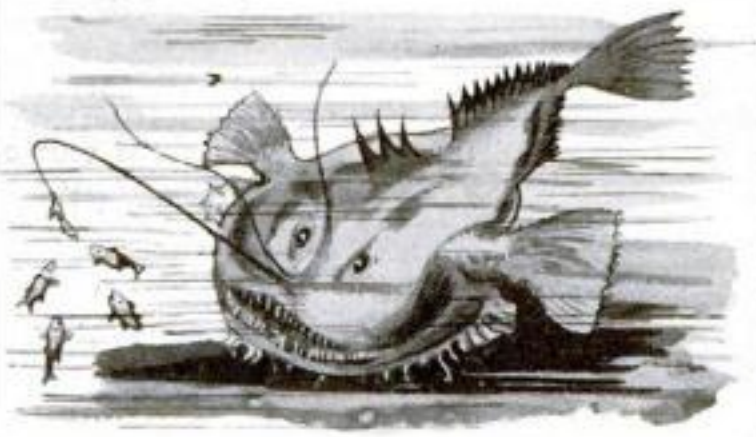
THE SURINAM TOAD (DUTCH GUIANA AND OTHER AMERICAN TROPICS) SOLVES THE HOUSING PROBLEM! THIS CURIOUS CREATURE IS A LIVING APARTMENT HOUSE! ITS PROGENY HATCH, AND ARE REARED, IN SINGLE ROOMS, OR CELLS, ON THE FEMALE'S BACK.

HERE IS AN ASTOUNDING FISH, ***THE CLIMBING PERCH*** (ASIA) THAT CLIMBS STEEP STREAM BANKS, AND WALKS OVER DRY LAND, PROVING THE OLD SAYING OF "A FISH OUT OF WATER" IS THE BUNK

THE MANATEE - THE STRANGE MAMMAL THAT GAVE RISE TO THE MERMAID LEGEND AMONG THE ANCIENTS, PROBABLY FROM ITS HUMAN LIKE HABIT OF ELEVATING HEAD AND SHOULDERS ABOVE THE WATER SURFACE!

BIG ROBBER CRAB (ISLANDS OF THE INDIAN AND PACIFIC OCEANS) BREATHES DRY AIR. IT CLIMBS COCO PALMS AND BREAKS OFF THE NUTS WHICH IT OPENS FOR FOOD WITH ITS GREAT CLAWS!

THE ELECTRIC EEL IS POSITIVELY SHOCKING!



PIPE THE MARINE IZAAK WALTON, ***THE ANGLER FISH***, FLOURISHING AN HONEST-TO-GOODNESS ROD AND LURE, TO CATCH HIS DINNER!

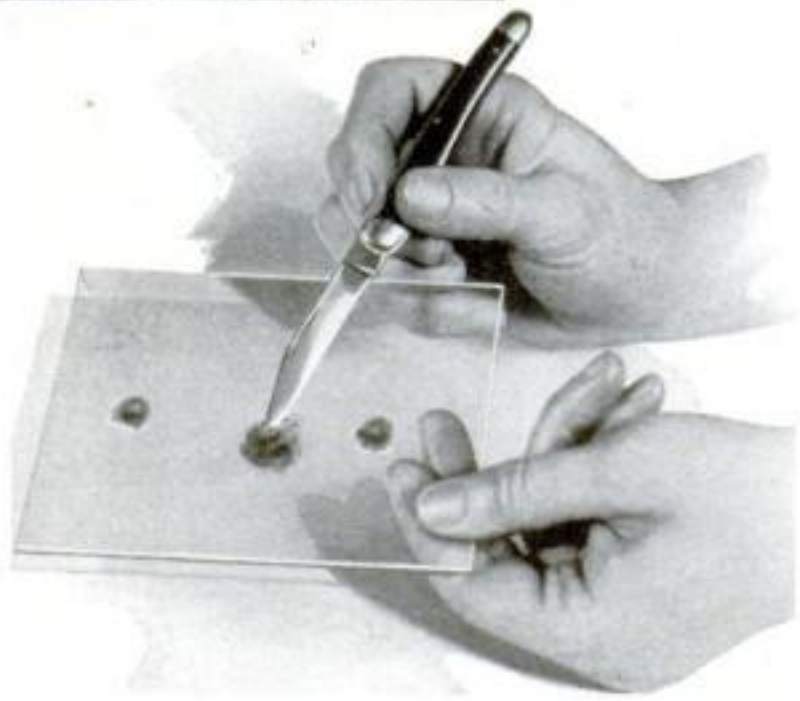
SOME of the strange freaks of nature leave one as puzzled as the cross-eyed kid at a six-ring circus. That's why we have named this page "Un-Natural History." It depicts some apparently dizzy and out-of-order facts in the realm of natural history. Freaks like these can make one wonder whether the laws of nature are being properly enforced.

HOME EXPERIMENTS EXPLAIN

Mysteries of Household Products

CEMENT FROM MILK

Casein, from which modern industry makes many products, is formed when dilute acid is added to a quantity of dilute skimmed milk. The precipitate is filtered off through a single layer of cheesecloth placed in a funnel. The experimenter can make a handy cement from casein



A drop of linseed oil, which has been treated with a homemade paint-drying compound, becomes tacky. The other drops, not treated, remain liquid. The drier acts by speeding up oxidation of the linseed oil

IMPRESSED by an array of test tubes and flasks, the family and friends of an experimenter who has set up a home laboratory are inclined to regard him as an expert in every conceivable branch of chemistry. They ply him with all sorts of practical questions. What kind of cleaning preparation will take out a certain stain? What will unclog a stopped-up drainpipe? What makes paint dry?

Solving all the problems that are trustingly put up to an amateur chemist might take years of study. Here are a few experiments with familiar household preparations, however, that will help supply some of the answers. Knowing how a commercial compound works, you can often prepare one that will do the job as well and at less expense.

One household stand-by you have worked with before is sodium hydroxide, or caustic soda, sold as lye at hardware, drug, and grocery stores. Years ago, housewives used it to make soap, by treating fatty substances with a solution of lye. You, yourself, may have made Castile soap from lye solution and olive oil, as described in a previous article in this magazine.

An important household use of lye today—removing obstructions from clogged drainpipes—depends upon a similar chemical action. Drain stoppages are caused by grease, which is insoluble in water, and which retards flow by reducing the inner diameter of the pipe. When a strong solution of lye is poured down the pipe, it reacts with the grease and turns the latter into a soluble soap, which is easily washed away.

Another alkali on your laboratory shelf—potassium hydroxide, or caustic potash—also reacts with grease to make soap. Would this chemical be as effective as lye for clearing a drainpipe? Try it, and you will find it works even better. The resulting "potassium soap" is more soluble than the "sodium soap" that lye forms. Lye is used in most commercial drainpipe cleaners, simply because it is cheaper.

Several new preparations for cleaning drainpipes contain silicon or metallic aluminum, besides lye. The lye reacts with the grease to form soap, as before, but it also reacts with the silicon or aluminum and releases hydrogen gas. This gas mechanically agitates the solution and turns the soap into a froth, making the cleansing action more effective. Place some cleaning compound of this type in water, in your laboratory, and you can collect the hydrogen gas that is evolved. The reaction between aluminum and a solution of caustic soda offers you a convenient new way of making hydrogen for laboratory experiments.

Since pipe-cleaning preparations depend upon the action of an alkali, you can see why a cleanser of acid type would be useless for this purpose. However, cleansers using an acid have other uses in the home. Such a one is sodium bisulphate, or sodium hydrogen sulphate, which removes stain from china and porcelain. When the stained surface is moistened, and the chemical is sprinkled on and rubbed vigorously, the stain is removed. Mechanical abrasion plays a part, but the action is principally a chemical one.

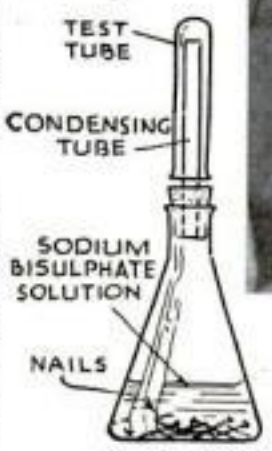
Sodium bisulphate dissolves in water to form a solution that behaves much like sulphuric acid, as you can readily demonstrate. Place some iron nails or wire, and a solution of sodium bisulphate, in a flask that is fitted with a cork carrying a glass tube. The tube should be of rather large diameter—say, three eighths of an inch—

and measure about five inches long.

Warm the flask, and you will notice that the iron is rapidly attacked. A cleaning preparation of this type is effective because it reacts with iron and other stains that are attacked by acids. Hydrogen is evolved in the process, and you can fill a test tube with the gas by dropping it over the glass tube. When the tube is closed with the thumb, and opened again with a lighted match held to the mouth, the hydrogen-air mixture produces a gentle explosion with a peculiar "plurping" noise.

Other cleaners work in different ways. Grease spots are removed from clothing by liquids such as carbon tetrachloride or gasoline; these dissolve the grease directly, without effecting any chemical change. You could remove grease from a clogged drainpipe with these liquids, but the process would be wasteful because of the amount of solvent required, and dangerous if an inflammable substance were used. Sodium peroxide and perborate, which remove stains from wood, owe their cleansing ability to their oxidizing effect. Oxalic acid has a bleaching action. Many scouring powders employ an abrasive to scratch or wear off the stain, but are fortified with some harmless alkaline agent like soda ash that helps the process by dissolving the discoloration or turning it to a less conspicuous color.

Paint provides an interesting material for home experiments. Most laymen imagine that when paint dries, the process is merely one of evaporation. It is true that the solvent, or thinner—consisting largely of turpentine—does evaporate like water. The hardening of the paint, however, has an entirely different cause; it is due to the oxidation of linseed oil by the oxygen of the air, under the accelerating influence of a substance called a drier.



This speeding-up effect of a drier is easy to show if a drop of linseed oil without it, and another containing the drier, are left side by side overnight. The treated oil will harden, while the other will remain liquid. You can try this test for yourself, since a small amount of drier is easy to prepare in a home laboratory.

Paint-drying compounds usually contain borates or resinates of manganese, cobalt, or other metals. A typical drier is manganese borate. To prepare it, dissolve in separate portions of water some borax, and a manganese salt such as manganese sulphate or manganese chloride. Mix the two solutions. A precipitate of manganese borate will form, and the flesh-colored substance may be recovered by filtering off the liquid. Pouring water upon the precipitate, while it is still upon the filter paper, will wash away any impurities. The filter paper may then be unfolded and the precipitate dried. Only a small amount of manganese borate need be mixed with linseed oil to make it harden, or become tacky, more quickly than untreated oil.

If you try mixing the drier you have prepared with machine oil, you will find it has no effect. Mineral oil does not oxidize in the air to form a tough protective film, as linseed oil and other vegetable oils do, and hence it cannot be used in a paint.

"Plant food" tablets, sold to stimulate the growth of potted plants in the home, need not mystify an amateur chemist. Obviously, what they contain is a fertilizing mixture, and it is easy to compound a similar homemade preparation that will benefit both house and garden plants. The following formula supplies the potash (potassium), nitrogen, and phosphorous that are considered essential for plant growth: sodium nitrate, one and one half parts; trisodium phosphate, one part; potassium sulphate, one part. The term "part" represents any unit of weight; for example, you may use one and a half ounces of sodium nitrate, one ounce of trisodium phosphate, and one ounce of potassium sulphate.

Powder the chemicals and mix them intimately. A pinch of the mixture, or about half a gram, should be sprinkled on the soil around a potted plant about once every two months. The plant should be watered after the chemicals have been applied. Be careful not to use too much of the mixture. A convenient way to handle it is to place it in a small vial or pill bottle, and to attach to the cork a little tin spoon, cut from sheet metal, for measuring out the dose of proper size.

The chemical plant food may *(Continued on page 110)*

In Your Laboratory, You Can Show How the Industrial Chemist Makes Billiard Balls and Buttons out of Ordinary Skimmed Milk

By RAYMOND B. WAILES

HOMEMADE "PLANT FOOD." A concentrated fertilizing mixture, like those manufactured commercially, being applied to a potted plant. The tiny spoon used for this purpose is shown in the drawing

Hydrogen, being lighter than air, can be collected in an inverted test tube. The novel method of making the gas in this experiment, without acids or alkalies, is illustrated at the left

Laboratory Stand Made of Metal Towel Bar

A PERMANENT and convenient support for beakers, flasks, and other laboratory equipment may be made from an all-metal towel bar. One of the ten-cent kind will serve. Straighten one of the curved ends and screw it to the table top. The other end, left curved, is attached to one of the end uprights of the chemical bench. This arrangement leaves plenty of clearance for tightening the set screws of rings, burette clamps, and other standard laboratory accessories. Details of construction are shown in drawing at right.

Build this Receiver *with*

The latest in radio parts and the last word in radio tubes are used in this up-to-date, six-tube, all-wave outfit

By WALTER J. BRONSON

The author obtained loudspeaker reception of foreign as well as local stations

HERE is your chance to build an all-wave receiver that makes use of the latest thing in radio parts—all-metal tubes.

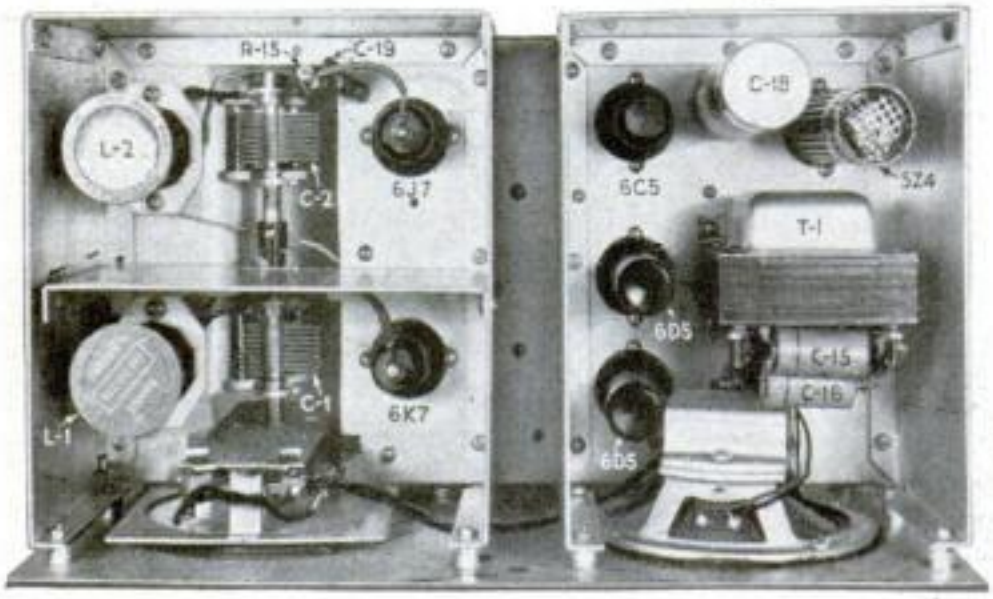
Five months ago, when the development of these "gas-pipe" units was first announced, POPULAR SCIENCE MONTHLY made special arrangements with the manufacturer to obtain an advance selection for use in an all-wave receiver. Various circuits were tried, tests were made, and accurate logs kept. The result is the carefully designed six-tube outfit illustrated and described in this article. It is easy and inexpensive to build and gives satisfactory loudspeaker volume on foreign as well as local short-wave stations.

The small size and all-metal design of the new tubes provide valuable constructional advantages over the glass type. They can be stowed away in small corners of a chassis, require no individual shielding, and will stand shocks and abuse that would ruin an ordinary tube. Also, since all the new tubes are provided with eight base prongs, of the same size, arranged in the same pattern, one type of socket can be used throughout.

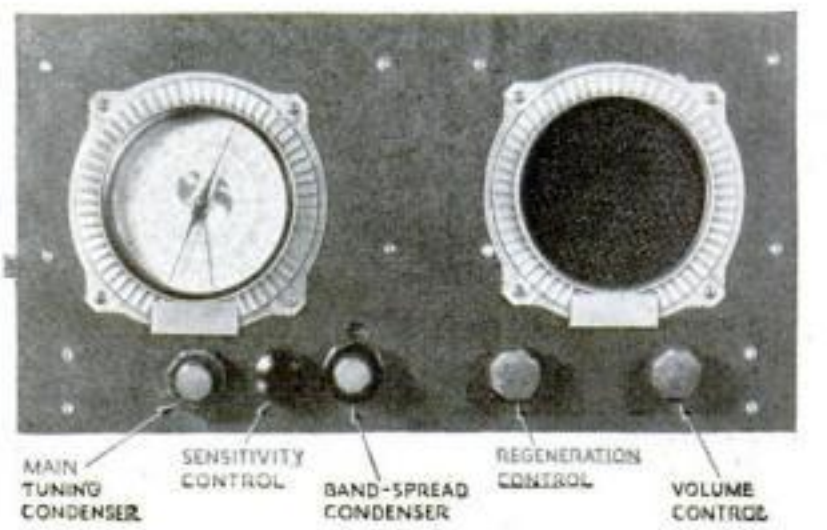
After a careful study of the characteristics of the new tubes available, the following types were selected for use in this all-wave circuit: The radio-frequency stage makes use of a 6K7 triple grid, supercontrolled amplifier tube. This gives a radio-frequency stage with ample gain, feeding into a 6J7 tube wired as a well-stabilized regenerative detector. To insure good tone quality of the audio transfer from the detector stage to the first audio stage, a high-impedance, plate-coupling choke is used; the grid of the first audio tube being resistance-coupled through a condenser to this audio choke. The first audio tube is a 6C5 detector-amplifier triode, while the second audio stage employs two 6D5 amplifier triodes connected in push-pull. For rectification, a 5Z4 full-wave rectifier is used.

Due to the high degree of sensitivity and selectivity of this receiver, a micrometer adjustment dial must be employed for tuning and setting the ganged tank condensers (C_1 and C_2), The rotating ratio of the tuning unit shown is approximately twenty-eight to one, using the small, center knob. A larger knob, mounted on the same shaft, provides a direct drive. Obviously, as with any selective receiver, the best tone quality is obtained only when the receiver can be tuned exactly, on a hair line, to the desired station. It is all too easy to skip over a station completely if the receiver is not properly equipped with sensitive controls.

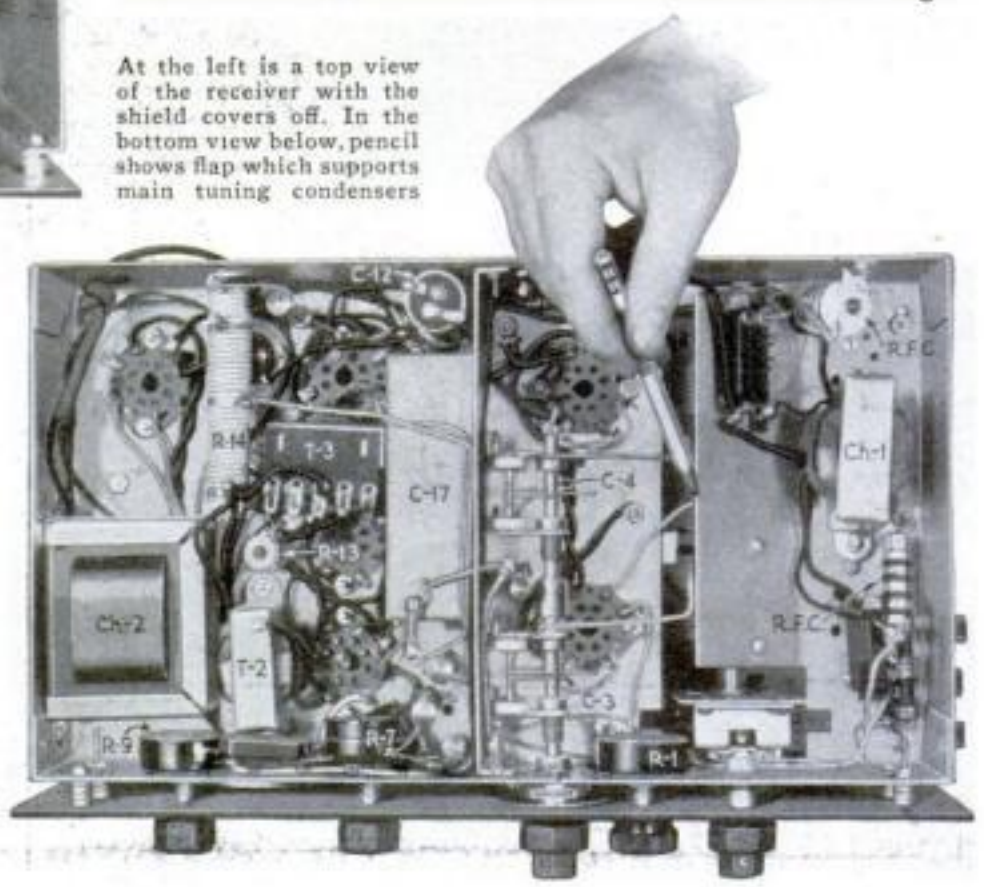
The small, three-plate, band-spread condensers (C_3 and C_4) are adjusted by a planetary drive having a ratio of twelve to one on the smaller knob and direct drive on a larger



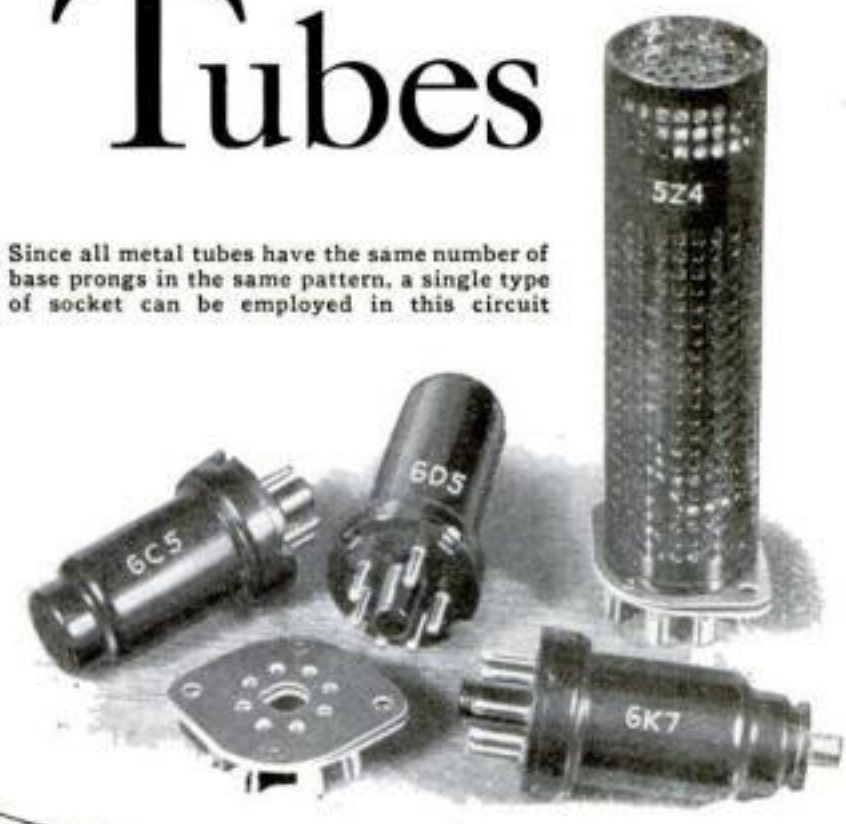
At the left is a top view of the receiver with the shield covers off. In the bottom view below, pencil shows flap which supports main tuning condensers



Dial, speaker grille, and controls on front panel. The handsome crackle finish is easily applied in the home radio workshop



New Metal Tubes



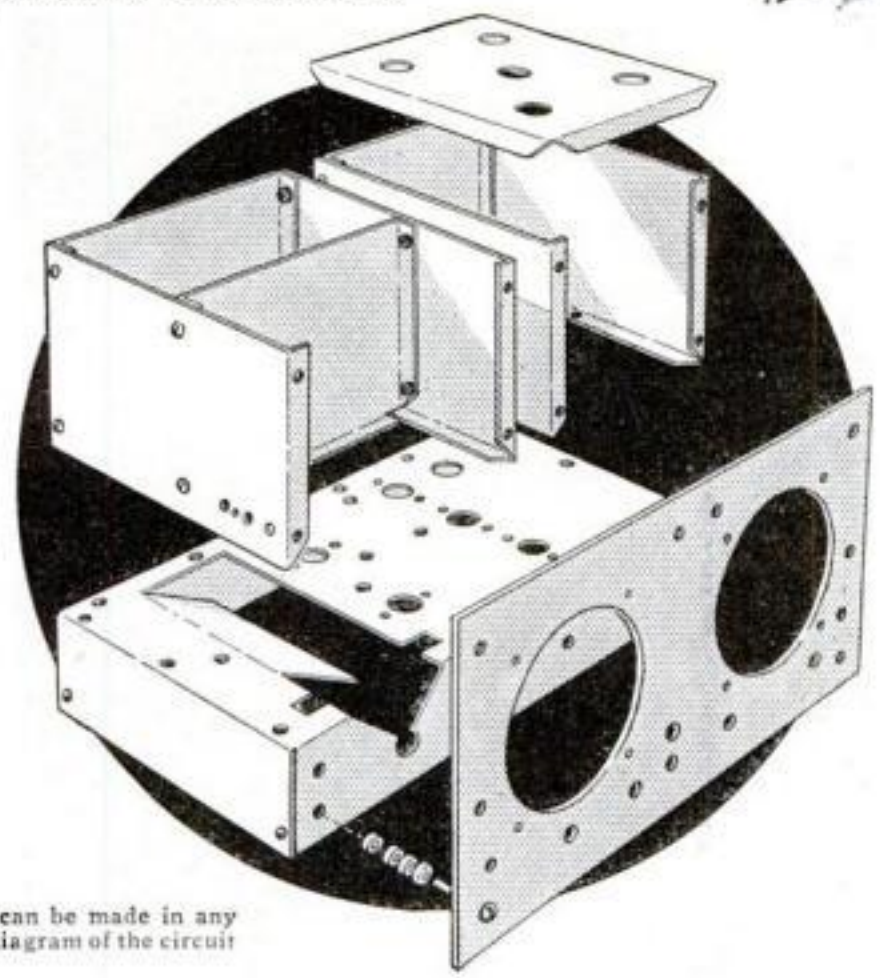
Since all metal tubes have the same number of base prongs in the same pattern, a single type of socket can be employed in this circuit

knob. If the planetary drive used is not equipped with some sort of calibrated dial, one must be supplied. In the original receiver shown, a small aluminum dial plate, calibrated in arbitrary units, was fastened to the large shaft of the drive.

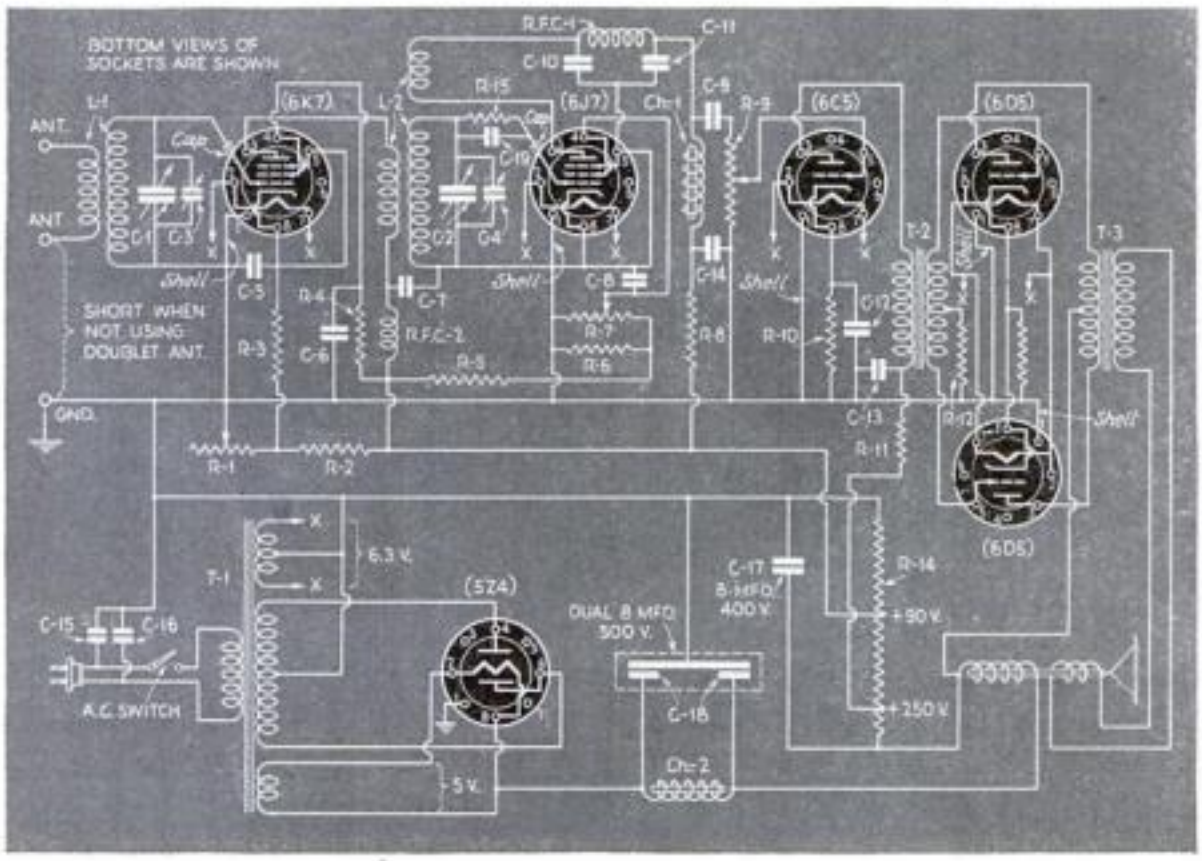
A 10,000-ohm variable resistance (R_1) connected into the bias supply of the radio-frequency tube (6K7) to provide sensitivity control is a distinct advantage of the circuit. Mounted on the front panel between the tank tuning knob and the band-spread knob this control serves a dual purpose, since in regulating the sensitivity it also varies the amount of noise picked up by the radio-frequency stage. Thus, in a relatively noisy location, the sensitivity control can be adjusted to a point just above or below the noise level. When this has been done, all stations, local and distant, will be received without local background noise or other disturbances due to man-made conditions.

Regeneration in the circuit is exceptionally well controlled by the 50,000-ohm volume control (R_7). This control is placed fourth from the left on the front panel. To insure noiseless operation, the moveable arm on this resistor is by-passed to ground through a one-microfarad, noninductive, paper filter condenser. In use, the regenerative and sensitivity controls should be adjusted together so as to obtain equal regeneration over the entire tuning range of the receiver.

Experiments with several types of plug-in coils showed that the most favorable results were obtained with commercial coils of the ribbed-form type illustrated. These coils (L_1 and L_2), are well matched to the 140-mmfd. variable condensers used and are inexpensive. Four-prong coils (L_1) are used in the radio-frequency stage and six-prong coils (L_2) are employed in the regenerative detector stage. Six coils in each stage, twelve in all, cover the entire broadcast and short-wave bands.



The panel, chassis, and shields can be made in any amateur's workshop. Below is a diagram of the circuit



Although the panel, chassis, and shields look like commercial products, they can be cut, bent to shape, and finished in any amateur's workshop. As the reader will note, the 8 by 15-inch panel cut from one-eighth inch thick sheet aluminum is mounted exactly one half inch away from the chassis and shields. This is to provide ventilation as well as ample space for mounting the four-inch tuning dial and the five-inch dynamic speaker. Half-inch spacers (washers will serve) are used in conjunction with long screws to fasten the complete panel assembly rigidly to both the chassis and the stage shields.

The black crackle finish on the front panel is easily obtained through the use of a recently developed paint product. This paint is applied rapidly with a brush and baked on in a gas oven.

A 13 by 19½-inch rectangle of aluminum serves as material for the 2½-inch-deep chassis. The metal can be bent easily to form a chassis measuring 2½ by 8 by 14½ inches. All four corners of the chassis should be riveted or bolted together by means of small aluminum or brass angles. A 2 by 8-inch cut-out on the top face of the chassis, two inches from the left-hand end and bent down to form an angle of thirty degrees, serves as a mounting for the tank condensers. This cut-out can be clearly seen in the photograph of the chassis.

The shields for the radio-frequency and detector stages can be bent to shape from a 6 by 24-inch sheet of aluminum, while the audio stage shield can be bent from a 6 by 23-inch sheet. When completed, the shields should measure 5 by 7 by 8 inches for the detector stage and 5 by 6 by 8 inches for the audio stage. Each should have a one-half-inch flange around its bottom edge. *(Continued on page 107)*

A PAGE OF NEW IDEAS

For the Radio Fan

Makes Neat Holes In Metal Chassis

PUNCHES and dies recently placed on the market provide one of the simplest ways of making neat large-diameter holes in metal chassis for tube sockets, electrolytic condensers, and coils. Because they produce smooth cuts without bending or otherwise marring the surface of the metal, they can be used on completely assembled chassis as well as on the flat stock. In use, a pilot pin in the die fits into a small hole drilled in the chassis and serves to center the punch. A sharp blow with a hammer is all that is necessary to drive the punch home. In the photograph above, the punch is being used to make holes in an assembled chassis.

Five-Meter Sets Used at Track Meet

AT A high-school track meet held recently in Los Angeles, Calif., five-meter transceivers constructed by amateurs proved their worth by making it possible for the spectators to hear the results of each event immediately after the contest was finished. A portable five-meter outfit stationed at the finish line of each race, flashed the results to another transceiver located at the control board and microphone for the general public-address system. From there, loudspeakers broadcast the information to the spectators, eliminating the usual period of suspense and uncertainty.—K. F.

Students announce track results received on short-wave transceiver

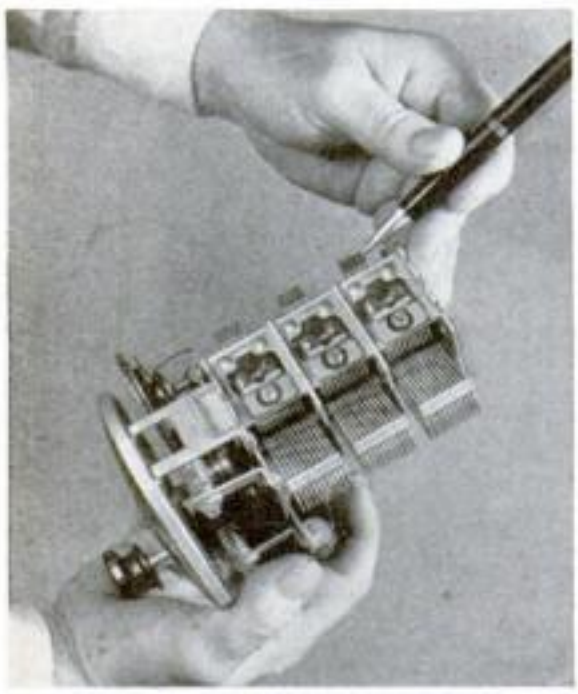
Wrench Set is Housed In Tool Handle

THIS socket-wrench set provides, all in one tool, almost every size of wrench needed in repairing and building radio receivers. It consists of a nickled-steel hexagonal shaft with a knurled handle and six removable end attachments to fit the shaft. Five of these attachments are socket wrenches, varying in size from three sixteenths to one half inch. The sixth is a medium-sized screwdriver. When not in use, the end attachments stow away neatly in the hollow handle where they are always handy and less likely to be mislaid.

Long-Handled Pliers Are Easily Made

AN INEXPENSIVE pair of long-handled pliers, useful for retrieving screws or nuts dropped accidently into a receiver cabinet, can be made from two lengths of bus-bar wire and an ordinary spring clip. Simply solder the two sections of wire to the hand grips on the clamp and your pliers are complete. A "third hand" such as this is a valuable time saver when it comes to holding small parts in place in the depths of crowded chassis while screws are tightened or soldered joints made. By using clamps of various sizes, a set of pliers can be made.

Single Knob Controls All Condensers



Pencil points to small band-spread condenser. Main tuning condensers are opposite on frame

COMBINING main condensers and band-spread condensers in one unit, the tuning assembly illustrated accomplishes with one knob and one dial what heretofore required the use of several controls. Both band-spread and tank or tuning condensers are mounted on the main frame of the unit and are controlled by a single knob located under a double-pointer dial. Pushed in, the control knob turns the main tuning condenser; pulled out, it rotates the band-spreading units.

Extension Rod Adjusts Trimmer Condenser

ALTHOUGH the amateur can alter the ordinary type of "postage-stamp" padding condenser to make it serve as an antenna trimmer condenser controllable from the front panel of the receiver (P. S. M., Apr. '35, p. 46), such units now can be purchased ready made. Designed for mounting on the inside, rear face of the chassis, the screw adjustment on the trimmer condenser is provided with an extension rod. This rod projects through a hole cut in the front face of the chassis and when fitted with a knob provides a convenient means for adjusting the compression plates of the mica condenser. The extension rod is long enough to fit almost any chassis, and can be cut as required to bring the control knob flush with the panel.

Knob on front panel controls screw adjustment of trimmer condenser

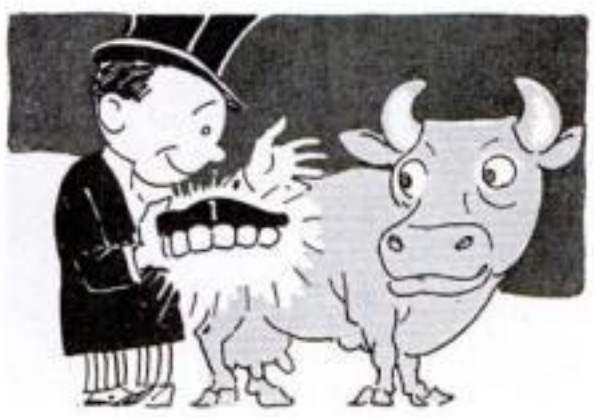
Question: Do parrotfish provide food for other fish? —W. B., Dallas, Tex.

Here's *the* Answer

A—THE green-toothed parrotfish upends in the water and allows numerous small fish, called wrasse, to clean its teeth and scales by eating all adhering debris.

But the Chinese Prize It

S. D. B., COVINGTON, KY. The prevalent idea that all jade comes from China is erroneous. The great jade mines of the world are in the northeastern part of Burma and along its border adjacent to Yunnan, China.



Could Use a Set of Uppers

C. F., WOONSOCKET, R. I. Cattle have no teeth in the upper jaw. In grazing, the vegetation is pulled, rather than cut off, by the lower teeth which press on the tough membrane covering the upper jaw.

Isinglass Has Fishy Ancestry

N. M. J., GREEN BAY, WIS. True isinglass is obtained from the swimming bladders, or sounds, of several species of fish. The finest isinglass is prepared from the sounds of sturgeons which flourish in certain Russian rivers, in the Caspian and Black seas, and in the Arctic Ocean. Isinglass is a pure form of gelatin. Mica, often confused with isinglass, is a mineral substance.

When Leap Year is Skipped

Q.—ARE there any occasions when a leap year is skipped?—D. S., Homestead, Pa.

A.—THREE times in every 400 years, the leap-year arrangement is omitted. This is accomplished by not reckoning as leap years the years ending in two ciphers, unless they are divisible by 400. Thus the year 1600 was a leap year but 1700, 1800, and 1900 were not. This procedure was adopted to keep the calendar more nearly in harmony with the solar year. By the year 4000, continuing to use our present calendar, there will be a difference of one day between the two years, calendar and solar.

Leaves Are Sun Shy

Q.—ARE there any plants on which the leaves grow in an edgewise position?—L. M. A., Forest Park, Ill.

A.—COMPASS plants, such as the Australian eucalyptus, rosinweeds of the prairies, and prickly cabbage of waste lands, turn their leaves edgewise in order to minimize the drying heat of the midday sun. The plants turn the flat surfaces of their leaves to the morning and evening sun so that the tips of the leaves always point to the north or south, hence their name.

A Colossus Among Clams

Q.—WHAT is the largest shellfish extant today?—A. M., Shreveport, La.

A.—THE giant clams, *Tridacna gigas*, found about the coral islands in the Pacific Ocean are probably the largest shellfish. Their shells frequently weigh 400 pounds. They have a life span estimated to be from sixty to 100 years.

Horseless Horsepower

E. F., FORT WORTH, TEXAS. Of the total installed horsepower in this country, it is estimated that motor vehicles account for eighty-five percent. This estimate places the total at approximately 1,672,000,000 horsepower, of which vast sum about 1,425,000,000 horsepower are in the nation's automobiles.

Not Even Polar Bears

R. E. B., TERRE HAUTE, IND. No fur-bearing land animals are found within the Antarctic Circle. Neither are there any true natives. The only wild life on the lands of this area are penguins and certain sea birds. Some species of insects have been noted by explorers. Whales and seals, which are marine mammals, constitute the only important animal life of the South Polar regions.

That Big Harvest Moon

Q.—WHY is it that the moon appears so large when you see it rising from the horizon? —M. B. L., Flint, Mich.

A.—THAT the moon appears larger when seen at or near the horizon than when higher in the sky is an optical illusion. When we look to the horizon, our vision takes in many objects on the way and we subconsciously reason that the distance is less than when we look straight up into space. Accordingly, the mind reasons that the moon being nearer to us, it must be much greater in size in order to have its normal appearance when high in the heavens. Actually, the moon is about 4,000 miles more distant from the observer when at the horizon than when at its zenith.

It's an Old Family Custom

Q.—IS THE manner in which animals rise, front feet or hind part first, an individual trait or is it characteristic of a whole species? —N. G., Eau Claire, Wis.

A.—CAMELS, goats, antelopes, giraffes, sheep, and bovine cattle invariably rise hind part first. Other members of the cudchewing family act similarly. All other large four-footed animals rise on their front legs first.

O. K., Blame the Indians

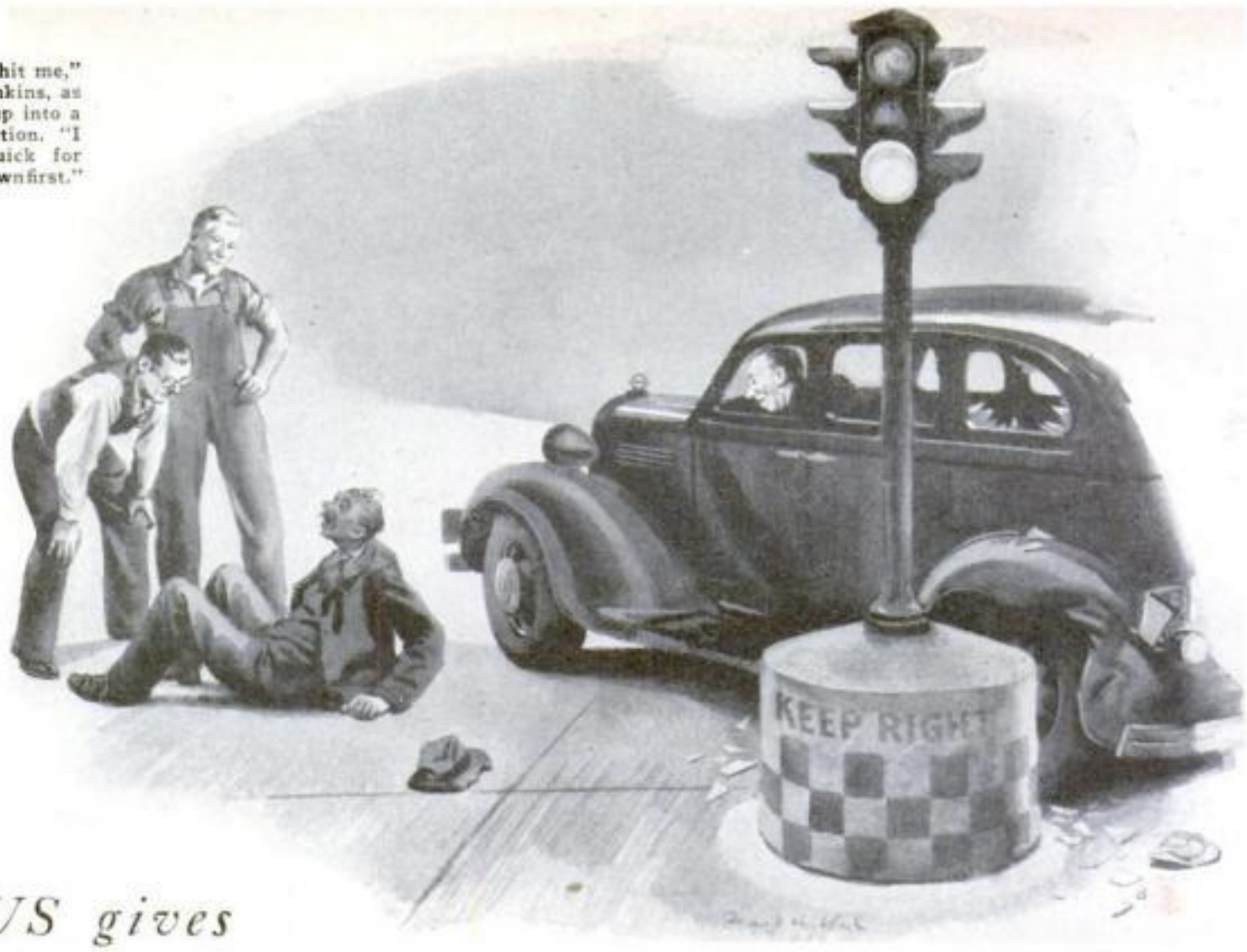
D. A., PRIMGHAR, IOWA. The origin of the term O.K. is not definitely known. One version of its origin is that it is a corruption of the Choctaw Indian word "okeh," meaning, "it is so and not otherwise." Another account attributes its origin to General Andrew Jackson who supposed the initials to be those of the phrase, "all correct." Still another ascribes its use first to Jacob Astor, founder of the Astor fortune, who employed the initials if he wished to make a satisfactory reply on an inquiry about a trader's credit.

Comet May Chase Its Tail

N. O. S., COUNCIL BLUFFS, IOWA. The tail of a comet is not formed until the comet comes near the sun and it follows the head of the comet only when the comet is approaching the sun. As the comet moves away from the sun, the tail precedes the head. The sun exercises a strong repelling influence on the surface of the comet. One explanation is that the surface of the sun is negatively charged with electricity and, as a consequence, drives out from the comet those particles which are similarly charged.

Plants With Twining Ways

H. L. M., BLOOMINGTON, ILL. There is no scientific basis for the common notion that twining plants twist around their supports in one direction, clockwise in the Northern Hemisphere and in the opposite direction in the Southern Hemisphere. The direction of twining seems, in most cases, to depend on the plant species and *(Continued on page 115)*



"He didn't hit me," grinned Dunkins, as he popped up into a sitting position. "I was too quick for him. I fell down first."

GUS gives

A Lesson *in* Careful Driving

By **MARTIN BUNN**

IT WAS later than usual when Gus Wilson, of the Model Garage, tightened the last nut on a rush job and decided to call it a day. The gray-haired veteran mechanic tossed the spanner into the kit, stretched to straighten the kinks out of his spine, and walked over to the sink where his partner, Joe Clark, was already washing up.

"Manville's coming for that bus first thing in the morning," he grunted. "Be sure and tell him—"

Gus's voice was drowned out in the wailing, tearing screech of rubber being dragged over concrete. The noise terminated in a sickening thud and the brittle tinkle of shattering glass.

"Cripes!" shouted Gus, tossing the soap into the sink and wiping his hands on his overalls as he rushed for the door. "Somebody's got bumped down at the crossing!"

The two garagemen ran out into the twilight.

A huddled figure was lying in the middle of the road at the crossing, a few feet in front of a sedan which had slued around and crashed its rear hub against the heavy, concrete base of the traffic light. Behind the wheel of the car a chalky-faced driver was feebly shaking his hands in a state of almost complete nervous collapse. One of the rear windows of the sedan, on the side toward the traffic post, lacked a large section of glass which had broken outward and crashed into the roadway.

Gus and Joe bent over the huddled figure. "It's Rummy Dunkins and he's soused to the eyes!" exclaimed Gus, as he caught sight of the man's face in the glow of the car's headlights and sniffed a heavy aroma of alcohol.

"Sure! Thash me!" grinned Dunkins, suddenly popping to a sitting position. "Only I ain't stewed, not to the eyesh yet, but I will be soon!"

"Where'd the car hit you?" Gus asked.

"What car?" countered Dunkins. "Oh! You mean that car, there? He didn't hit me! I wash too quick for him. I fell down first!"

Gus dragged Dunkins to his feet and let him stagger off down the road. Then the garageman walked around to the window of the sedan.

"Snap out of it, mister. Nobody's hurt!" he grinned to the driver, who was staring pop-eyed at the lurching figure of his imagined victim.

"And maybe that isn't a relief!" the car owner gasped, as his face regained its normal color. He fumbled for a cigarette in a limp package and lighted it with trembling fingers.

"Run the service car down here, Joe," said Gus after a quick inspection of the rear axle of the sedan.

It developed that the owner was on his way to visit relatives in the town, so the garagemen delivered him to his destination after towing his car to the Model Garage.

The next day, just as Gus was finishing the repair work on the sedan by fitting a new hub cap, the owner arrived.

"Good afternoon, Mr. Montrose," Gus greeted him. "She's just about ready for you."

"Looks as good as new," Montrose smiled. "Only thing is, I'm wondering if I've got the nerve to tackle driving again. I haven't been at it long, as you probably guessed, and that affair last night sure took the starch out of me."

"You're less likely to have an accident now than you ever were before," Gus asserted with conviction.

"If I do, it certainly won't be my fault," said Montrose, with equal emphasis.

"I wish Captain Williams of our police force could hear you say that," laughed Gus. "Maybe you don't know that the police departments all over the country are making a drive to cut down the number of auto accidents. They think that when 36,000 people are killed by cars in one year, something has to be done—and they're doing it, too. But what they've done so far isn't a patch on what they could do if people would really coöperate."

"How do you mean, 'coöperate'?" Montrose asked.

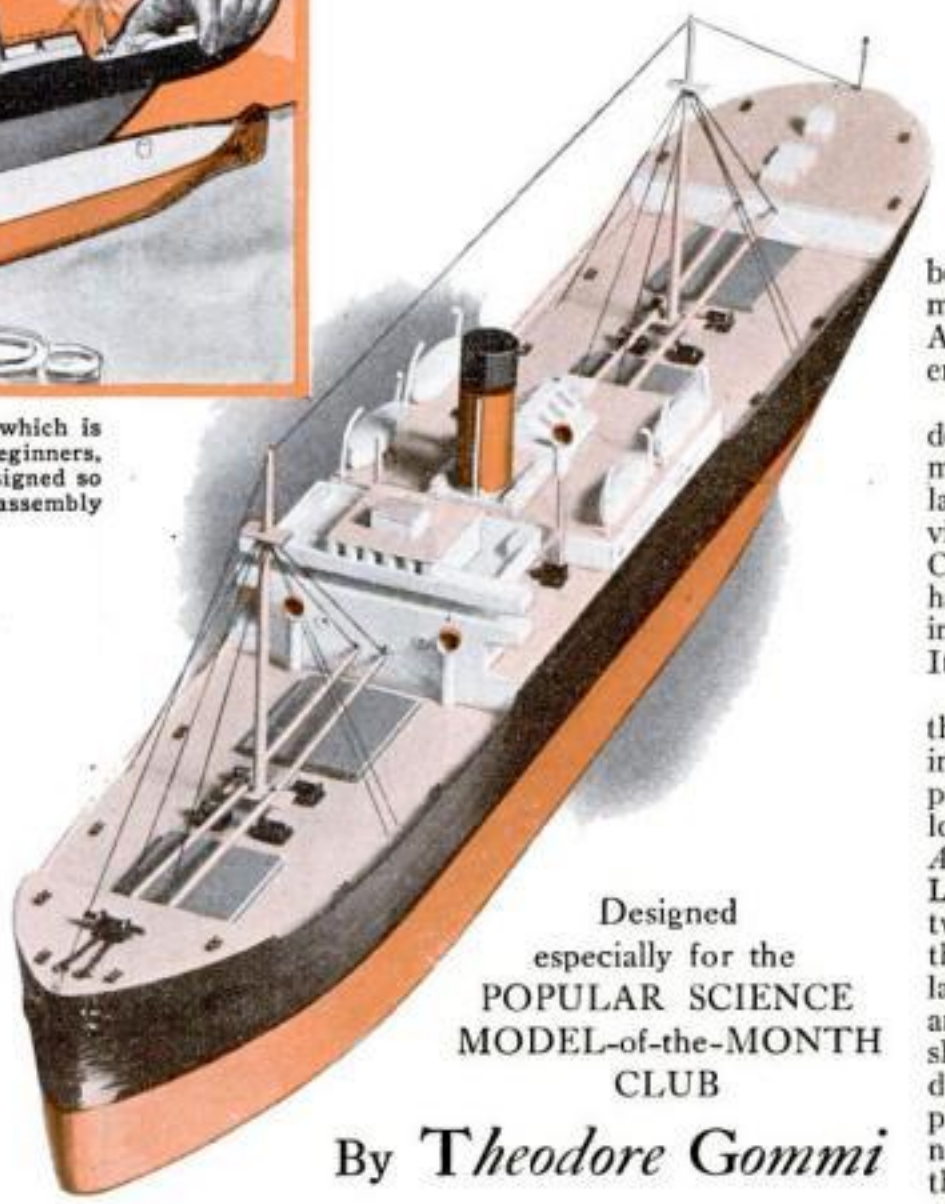
"That's easy to answer," replied Gus. "If the average driver would get it into his head that there just weren't going to be any accidents caused by anything he did, that attitude would make a whale of a difference."

Montrose laughed. "I never knew anybody started out with the idea that he was going to get into a crash."

"They don't, directly," Gus explained, "but they do what amounts to the same thing. They are always willing to take a chance. They'd rather trust in Providence and their own good luck than in common sense and careful *(Continued on page 112)*

PICTURESQUE Freighter Model *of Simple Construction*

To simplify the painting problem, which is one of the most troublesome for beginners, the parts of the model have been designed so they may be painted before the final assembly



Designed especially for the POPULAR SCIENCE MODEL-of-the-MONTH CLUB

By *Theodore Gommi*

TOO little attention is paid, nowadays, to the humble freighter as it goes from port to port and sea to sea, bearing the brunt of the world's commerce while the ocean liner takes all the glory. Surely if romance still exists in commerce, it is typified by these hard-working ships, just as it was represented centuries ago by the caravels that set out to find trade routes and discovered continents instead.

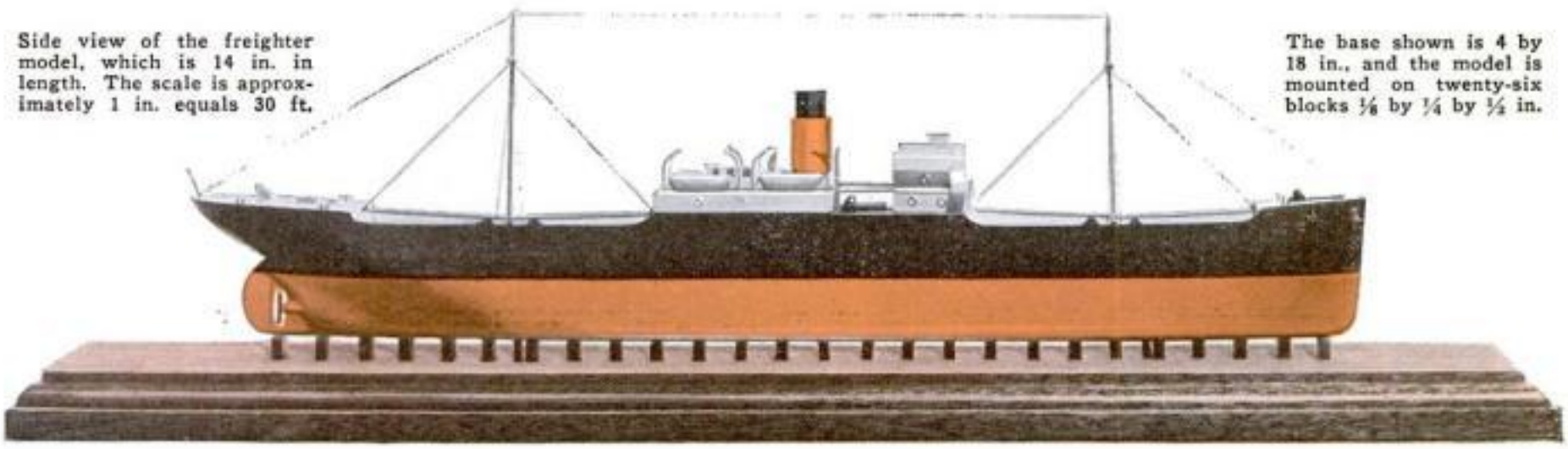
We have therefore chosen a typical freight steamer as the October project of the Popular Science Model-of-the-Month Club. No particular ship has been copied, but the model closely follows the lines of the famous war-built "Hog Islanders" that now carry the Stars and Stripes into every known port. These ships are about 400 ft. long and 6,000 tons gross. While the graceful sweep of decks and rigging is missing, they have a trim and businesslike appearance.

White pine or basswood are best suited for a model of this size, though balsa may be used, and the remaining materials are easily obtained. A complete list is given at the end of this article.

In order to allow for more detail, the scale—approximately 1 in. equals 30 ft.—is larger than that used for previous Model-of-the-Month Club ships, and the freighter has a full hull instead of being merely a water-line model. It is 14 in. long.

Begin the construction with the hull. To facilitate the shaping of the counter and sternpost, saw a slot about 2¼ in. long down the center of piece *A*, as shown in the drawings. Lightly nail *A* to *B*, or use two dowels without glue, so the parts can be separated later. Glue *C*, *D*, and *E* to *B*, and then proceed with the shaping. The cross-section diagrams are included in the plans for guidance, but it is not necessary in a model of this size to make templates.

Round out the hull at the stern to the approximate shape of the dotted line shown in the side elevation. Insert the fiber piece *F* into the slot previously cut into *A*, (Continued on page 102)



Side view of the freighter model, which is 14 in. in length. The scale is approximately 1 in. equals 30 ft.

The base shown is 4 by 18 in., and the model is mounted on twenty-six blocks ⅛ by ¼ by ½ in.

Keene's cement, a material often used by plasterers when they need something harder and smoother than common plaster, is mixed with water, colored with plaster colors, and cast in forms made from ordinary kitchen utensils

The method is so simple and inexpensive that it may also be used for casting play dishes for children's tea parties. It doesn't matter then how many dishes are broken; any number of new ones can quickly be made

HOW TO CAST BEAUTIFUL

Bowls and Flowerpots

THAT LOOK LIKE MARBLE

HERE is a novel type of handicraft that will appeal to every member of the family. The flowerpots and bowls illustrated are much more beautiful than they appear to be because the exquisite coloring cannot be reproduced, yet they require no special skill to make and cost next to nothing.

Mother can have just as many flowerpots as she wants, and she can change the color scheme every month if she desires. Six-year-old Dorothy can make her own play dishes by the dozen. Twelve-year-old Jack can earn some extra spending money by starting a factory at home and selling artificial marble products to friends and neighbors. That leaves Dad out, but never fear! He will be in it up to his elbows in no time.

You will see from the accompanying photographs that the articles are cast in forms improvised from household utensils of various sizes and materials. The size and shape of the articles you can produce are limited only by the available utensils and your own ingenuity. Just a few possibilities are pin trays, ash trays, fruit bowls, flower bowls, and vases.

Suppose you select a flowerpot for the first piece. The material required is about two cents' worth of Keene's cement and less than one cent's worth of plaster color. Since you will wish to make several things, it is wise to purchase about a quarter's worth of Keene's cement and spend five cents each for four or five plaster colors. Black, blue, red, green, and yellow will give a good variety. Mortar colors are not as satisfactory as plaster colors.

Keene's cement is a white, finely ground, slow-setting cement often used to plaster bathrooms and kitchens that are to receive an enamel finish. The cement when finally set presents a very hard, smooth surface. It can usually be purchased at building supply firms in any quantity. The plaster colors are dry mineral coloring pigments and may be obtained at the same place as the cement.

The form is easy to assemble. Simply use a jelly glass and a teacup that is at least ½ in. larger in diameter and rather tall. The one pictured was purchased for five cents in a dime store and is of 3⅜-in. inside diameter and is 3¼ in. tall. To complete the form, cut a strip of tin or light galvanized iron about ¾ in. wide and long enough to encircle the top of the cup above the handle with a good lap. Hold this collar in place with wire or strong cord. Now set the glass inside the cup and measure to ascertain how high it needs to be to give about ⅜ in. space in the bottom.

The amount of cement needed for the mix is one fourth more than the amount of dry cement required to fill the form. The amount of water needed is slightly more than one third the amount of cement by volume.

After the form has been used to determine the amount of cement needed, the cup should be coated on the inside with what is called "dope," and the jelly glass should be coated on the outside. The best dope is made by heating paraffin to a liquid state and adding an equal amount of kerosene. The result, when cool, is a paste of about the consistency of paste shoe polish. Lacking the paraffin, you may use any kind of grease that will not discolor the cement too much. The glass should be nearly filled with sand to hold it down in the cement.

The mixing may be done in any clean utensil that is not rusty. A tinned spoon is useful for doing the mixing. When the cement and water have been stirred together to a smooth mass that handles easily but is not sloppy, the colors may be added. There is no need to hurry because Keene's cement may be retempered by adding water and cast as long as two hours after the first mixing.

If a solid color is wanted, mix the color thoroughly in all of the batch. Do not use more than ten percent as much color as you have cement. If you wish a marbleized effect, mix a little of one color into part of the batch and a different color in another part. These colored areas should be stirred together slightly, or they may be mixed when putting the cement in the form to give a marble appearance.

By
Everett G. Livingston
Assistant Professor of Industrial Arts, Iowa State College

Several finished bowls and the forms in which they were cast. The form for the fruit bowl, although not shown, was merely two common vegetable bowls. *At right:* The flowerpot and its form

Ordinary kitchenware is used for molds . . . The special cement and colors cost only a few cents for each article

Now place the cement in the cup and bump the cup against the table several times to jar out the air bubbles. Set the glass carefully in the center of the cement and press it down to the desired depth. That operation should squeeze the cement up around the glass to the top of the band around the cup. See that the glass is properly centered, wipe off any overflow of cement, and place the cast in a cool, clean place to set.

About twenty-four hours later, you should be able to remove the form. First take off the metal band and pour out the sand. Warming the glass by pouring hot water in it will soften the dope and facilitate the removal. The cup also may be warmed by setting it on a radiator or in hot water. Pouring cold water inside the cast will help since it seeps through to the cup. Tapping the cup lightly will sometimes jar it loose.

When the form has been removed, the flowerpot needs to have the rough edges dressed off and the surface improved by sanding. If you can get what is known as "wet-or-dry" sandpaper, which is waterproof, in sizes 4/0 and 8/0, the sanding operation can best be done under water in a pan or a sink. Use the coarser paper to smooth the edges and level the top; then sand the pot all over with the fine.

When removed from its form, the casting is rubbed with waterproof sandpaper, used wet

The pot should now be allowed to dry until it is just slightly damp before the final polishing with fine sandpaper. It should be dry enough so that the colors do not smear, but not bone-dry. By alternately sanding with worn, fine sandpaper and polishing with a dry cloth, you can produce a good luster. A buffing wheel on a motor may be used to advantage in this process. The best results are obtained by sanding and polishing a little each day for several days.

Although these pots are not waterproof, plants may be set directly in them. The result is that the pot will always be slightly damp, and occasionally a little roughness will appear on the outside. A few minutes' work with fine sandpaper will put it in shape again, however.

Perhaps you would like to apply some sort of paint or other material to the Keene's cement. In that event it must be bone-dry, which takes a week or ten days.

The flowerpots may be waterproofed by painting them on the inside with liquid rubber, which is expensive, or coating them with aquarium cement; or they may be given several coats of good waterproof varnish on the inside. Another possibility is to use a commercial cement paint.

Impregnating the pots with paraffin is a still better way. It not only makes them practically waterproof, but also brightens the colors and adds to the luster. Place the pot and the paraffin in a double boiler and bring them gradually to a temperature that will melt the paraffin. Roll the pot around in the hot paraffin for several minutes and then take it out. There will be no apparent coating of paraffin on the surface. The inside may be given a heavier coat by pouring the pot full of melted paraffin and then pouring out the remainder after a layer has been deposited by cooling.

If the pots are waterproofed, they may then be treated on the outside to enhance the richness of the colors and the luster of the polish. Several coats of linseed oil produces a pleasing effect, but slightly tints the white. Warm the cement and the linseed oil and apply the oil generously with a cloth or a brush. Allow it to set for about an hour and wipe off any oil that remains on the surface. Repeat the operation in about twenty-four hours. Several applications of linseed oil may need to be applied before the surface seems no longer to take it up readily. A light sanding and polishing between coats helps develop a smooth surface.

After the final coat has set at least twenty-four hours, it may be brought to a high luster by the use of paste furniture wax, or a coat of dammar varnish or colorless linoleum lacquer may be put on.

Bowls and other pieces are made in much the same way as the flowerpot.

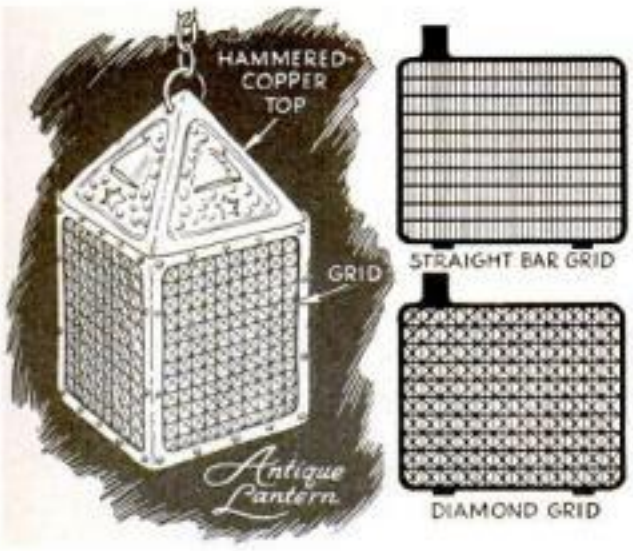
OILCLOTH IMPARTS CANVAS TEXTURE TO PHOTOS

Glossy printing and enlarging papers can be given an artistic canvas texture by squeegeeing them on oilcloth instead of the usual ferrotype plates. This is a valuable expedient for amateur photographers who do most of their work with ordinary glossy papers and do not keep on hand a variety of other papers for occasional artistic prints.

Any good grade oilcloth may be used if it is a plain color, has a smooth, even mesh, and is without imperfections. Paste or glue it on a smooth, firm support. A sheet of glass, covered on both sides, provides an ideal surface. Should wood be used, it must be perfectly smooth. Paperhangers' paste or flour and water cooked to the right consistency is a satisfactory adhesive.

The oilcloth surface needs no treatment to prevent prints from sticking. Merely wipe it with a damp cloth to keep it clean. Prints may be taken directly from the wash water, and will peel off readily when dry. However, the print will lie flatter when dry if first soaked for half an hour in a ten percent glycerin solution before it is squeegeed.—Alvin J. Brault.

MODEL FITTINGS FROM BATTERY GRIDS



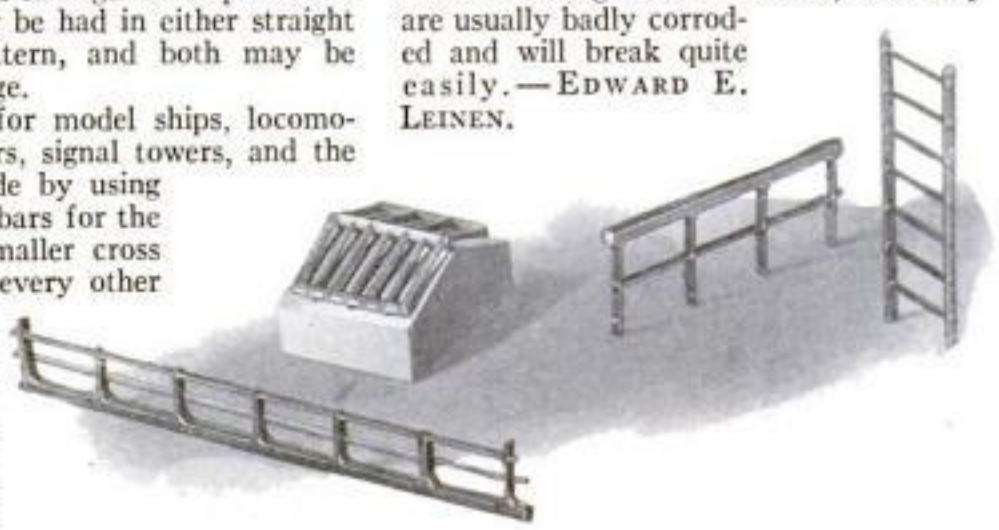
BY PURCHASING new positive lead grids from a local storage-battery repairman, I solved the problem of making small ladders and railings for ship models. These grids may be had in either straight or diamond pattern, and both may be used to advantage.

Fine ladders for model ships, locomotives, freight cars, signal towers, and the like can be made by using the heavy cross bars for the sides and the smaller cross bars for rungs, every other section being omitted. Gratings for ship hatches and railway signal towers can be prepared in the same way.

The diamond pattern makes excellent railings for ship models and can also be used as window sash or for fancy grillwork on model houses. To shape and cut the grid, use a razor blade, and smooth up with fine sandpaper.

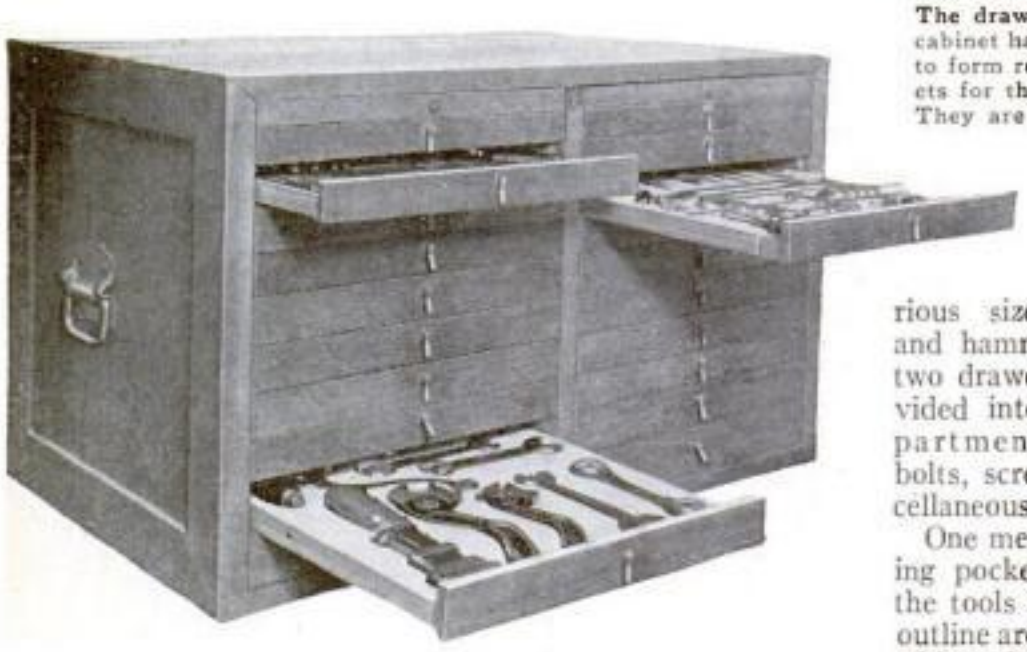
An excellent antique lantern may be made by fastening four full grids together. The top and bottom may be of brass or copper, lightly hammered to shape. Colored glass or transparent material placed behind the grids will add to the appearance.

There are innumerable uses for these battery grids, but be sure to get unused ones. Old grids might still have some of the sulphuric acid clinging to them and would be dangerous to handle; and they are usually badly corroded and will break quite easily.—EDWARD E. LEINEN.



Railings, a ladder, and a hatch grating cut from lead storage-battery grids, which are useful for making many parts of models

CABINET HAS RECESS FOR EVERY TOOL



The drawers of this tool cabinet have been cut out to form recesses or pockets for the various tools. They are lined with felt

UNLESS every tool in your shop has its own place and is put back after you are through working with it, you are certain to waste much time. There are many good ways to rack your tools—wall panels, open shelves, and boxes—but cabinets are among the best because they give better protection to the tools.

The size of the cabinet will naturally be made according to your own supply of tools or specific needs. It should be of strong lumber, and sufficient allowance made so that the drawers will slide easily. The cabinet illustrated is 24 by 28 in. with a double tier of drawers, 12 by 19 in. Each drawer contains its own type of tools, such as drills, chisels, screwdrivers of various sizes, wrenches, and hammers. One or two drawers can be divided into small compartments for nuts, bolts, screws, and miscellaneous hardware.

One method of forming pockets to receive the tools is to draw an outline around each tool with a flat-sided pencil on a board about 5/16 in. thick, which can be used as a false bottom in the drawer. A jig saw is used to cut out the pattern. Each opening should be smaller than the tool itself so that the tool will set in not quite halfway. The edges can be cut out on a slant or rounded off with a chisel if necessary, and a gouge may be used to cut any deep spots. A felt lining may then be glued in place.

A better and more workmanlike cabinet drawer can be made by using a board ¾ in. thick for the bottom. After the outlines of the various tools have been drawn, a gouge is used to cut out the desired form so that each tool rests evenly in a perfectly fitting pocket.—C. B. SMITH.

SLIDING FRAME MARKS DATE ON CALENDAR

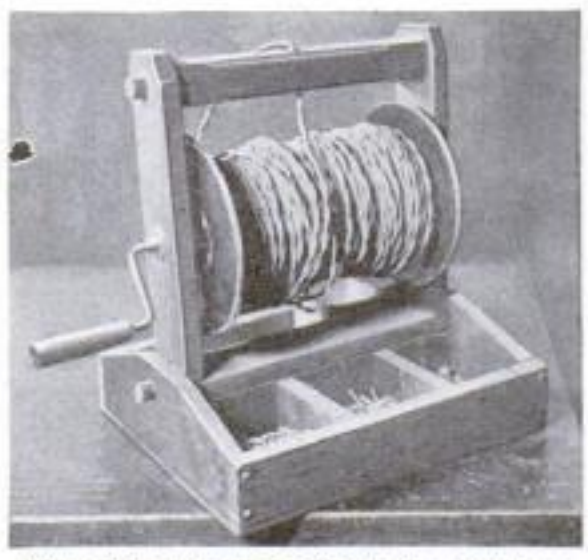
A RUBBER band and a square of black paper, used as shown above, make it easier to read the date on any ordinary calendar. A small piece of black paper is folded double over a rubber band and pasted together, a small space being allowed at the crease so that it will slide freely on the rubber band. A square opening is then cut in the paper through which to observe the date. The mask is used to form a black frame around the current date by sliding it along the rubber band daily to the desired position.—JOSEPH JAMIESON.

CALKING WITH RUBBER

TO USE modern pliable calking compounds of rubber, one must look for other means of applying it than the old putty-knife method. Its tendency to stick to anything it touches makes neatness, economy, or speed impossible. This difficulty may be overcome by obtaining an old grease gun of the screw type, which will eject the rubber putty in an endless worm about ⅛ in. in diameter.—E. J. WOLACK.

HAND REEL ON TOOL BOX HOLDS WIRE SUPPLY

ELECTRICIANS and wiremen can prevent wire from getting tangled and can keep necessary material within easy reach while working on a job by using a tool box like that illustrated below, with a small hand reel attached. The box is carried along as the wire is strung.—RAY BLAIN.



Wiring jobs may be speeded up by mounting a reel on the ordinary electrician's tool box

The Art of Making Beautiful

INLAID PICTURES

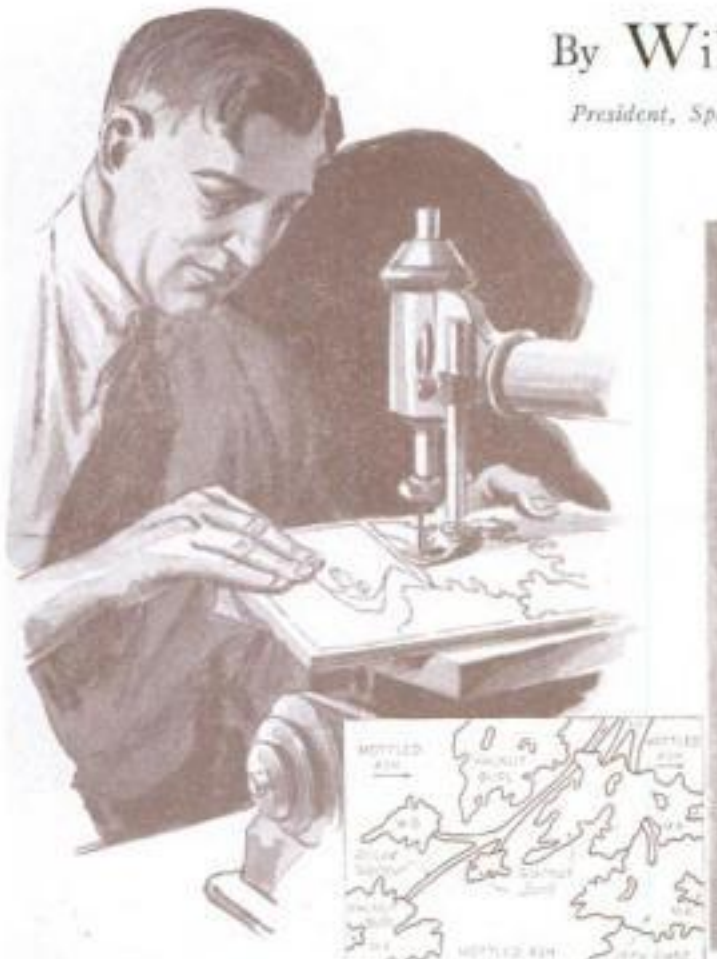
FROM WOOD VENEERS

By William E. Mitchell

President, Spokane Homecrafters, Spokane, Wash.

Official Magazine
POPULAR SCIENCE MONTHLY

A NUMBER of amazingly fine wood-inlay pictures were displayed at the National Exhibition and Contest of the National Homeworkshop Guild in Chicago last March. The most artistic of them all, the judges decided, was one entered by William E. Mitchell, of Spokane, Wash. POPULAR SCIENCE MONTHLY accordingly asked Mr. Mitchell to prepare simple instructions for this type of work.



THE WOODS USED
This diagram shows the woods chosen by Mr. Mitchell. Faux satine is also known as cypress crotch; mottled imbuya as Brazilian walnut; mottled ash as satin ash

"Shady Cove"—a simple but exquisitely colored picture sawed from wood veneers

INTARSIATURA, or the art of making inlaid pictures from fine veneers, is rapidly becoming popular among amateur craftsmen. With the aid of a modern electric jig saw, it is comparatively easy to do, yet the results are attractive and valuable. The materials themselves are comparatively inexpensive, and many dealers now stock a large variety of suitable veneers.

So old is intarsiatura that it was practiced extensively in Italy in the fifteenth century. At that time pieces of the utmost artistry were made with very crude tools and materials. The home worker of today, however, experiences few of the difficulties that confronted old-time craftsmen, and for that reason the art is enjoying a revival.

The tools and materials necessary are a jig or scroll saw, several dozen fine jig-saw blades, a variety of veneers, tracing paper, a few sheets of transparent cellulose wrapping material; white, stain-free casein glue; ½-in. gummed paper tape, and some pasteboard. The author uses a blade .008 in. thick and .028 in. wide with 38 double teeth to the inch. It has a rounded back and is commonly known as No. 38. This blade is a little more expensive than jeweler's blades, but does not break so readily. A few extra fine blades with about 70 teeth an inch are useful for very delicate work.

Landscapes, figure pieces, portraits, conventional ornaments—almost anything that can be painted may be worked out in veneers. It is best, however, to select relatively simple subjects of a type that can be represented by veneers without straining for effect or violating the canons of good taste.

The inlay picture "Shady Cove" shown in the accompanying illustration has been prepared especially as a first piece for beginners. No great accuracy is required either in copying it or in doing the cutting, but all the essentials of the art may be learned by carefully following out the processes required to make it.

The first step is to prepare a full-size drawing 6 by 9 in. and trace it with India ink on a sheet of cellulose wrapping material. The tracing is to help find appropriate grains and swirls in the veneers to be used. This is done by going over the veneer and looking through the finder to select the part that is best adapted for use in each particular detail of the picture. For instance, in selecting the sky wood for the picture illustrated, the finder was run over a piece of mottled ash to obtain the cloud effect. When selected, the part was marked and cut later. The same procedure was followed for the foliage, water, bank, rocks and bluff, and all other parts. It is through this finder that the various parts are visualized.

After selecting the veneers, cut out enough to allow an overlap of ¼ in. beyond the lines of the drawing. Then take pasteboard the same thickness as the veneer and cut openings into which the pieces of veneer can be fastened in their correct relative positions, as shown in the left-hand illustration on page 74. Fasten the veneer with ½-in. gummed paper tape. The photograph just referred to shows sliced walnut for the tree branches, light mahogany for the horizon, and faux satine for the beach, all taped. The openings, of course, are first marked on the pasteboard by use of the finder.

The object in using the pasteboard is to save veneer and reduce the thickness of the pad to be described later. If one does not care about the expense in waste veneer, the pasteboard may be eliminated and veneer the full size of the pad can be used. The leaves of the pad, whether pasteboard or veneer, should be cut 7 by 10 in., thus allowing a ½-in. margin all around the picture.

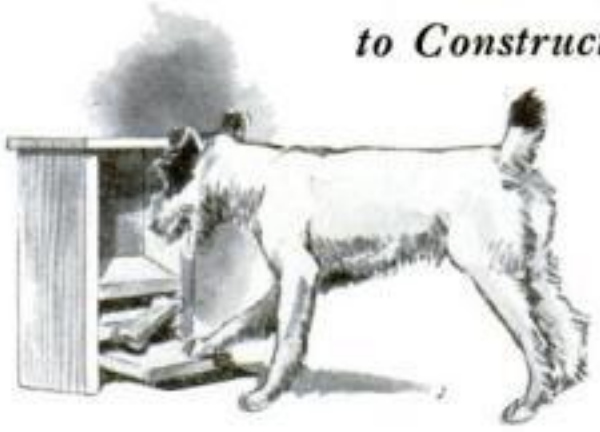
THE next move is to cut two pieces of ⅛-in. whitewood to form the top and bottom of the pad. Lay down one piece of the whitewood and pile on this the various leaves, being careful to arrange them so that the saw lines in the drawing will cut through the veneers selected for each part of the picture. When the leaves are all placed, put on the other piece of whitewood to form the top of the pad. Fasten all together by driving brads ¼ in. in from edge and about 1½ in. apart.

On tracing paper, make a tracing of the drawing and paste this on top of the pad, as shown. All lines are saw lines, and care should be used to follow these with the saw. Drill holes for threading the saw on the edges of the darker wood; these holes are to be filled later with composition wood crack filler. Have the saw blade exactly perpendicular to the saw table. When such fine blades are used, this will give as close-fitting joints as are humanly possible to obtain. Run the saw at 700 or 800 revolutions, and feed *(Continued on page 74)*

CRAFTWORK

Five Out-of-the-Ordinary Projects That to Construct . . . Each Has Some Feature

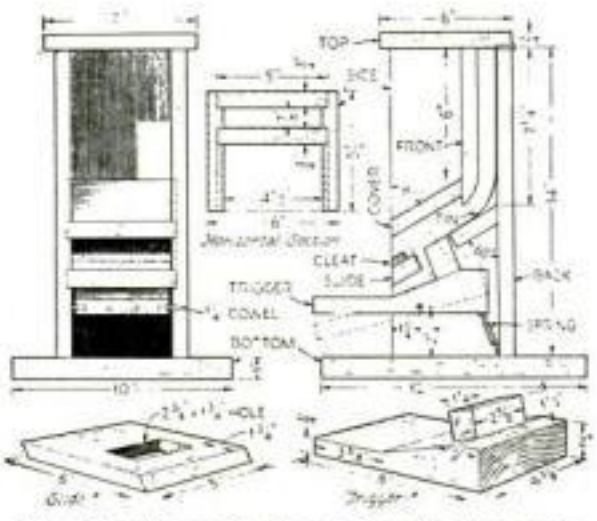
AUTOMATIC FEEDER LETS DOG GET OWN BISCUITS



ANYONE who owns a dog can have a lot of fun constructing an automatic feeder. All the dog has to do is to step on a board to release one biscuit—a trick easily learned, but one that will surprise and amuse your friends.

The feeder is designed to hold five dog biscuits of the so-called "milk and bone" variety, but it can be made to hold more if its height is increased. Any odds and ends of lumber may be used.

The parts are sawed and planed to dimensions, after which the rabbet for the back, the groove for the front, and the dadoes for the slide and cover are laid out and cut on the two sidepieces as shown in the photo above, where one side has been removed to show the construction. If no machinery or special planes are available, the grove and the dadoes may be worked out with a back saw and chisel. The rabbet may be omitted if the back is made ½ in. narrower and merely fastened to the sides with screws.



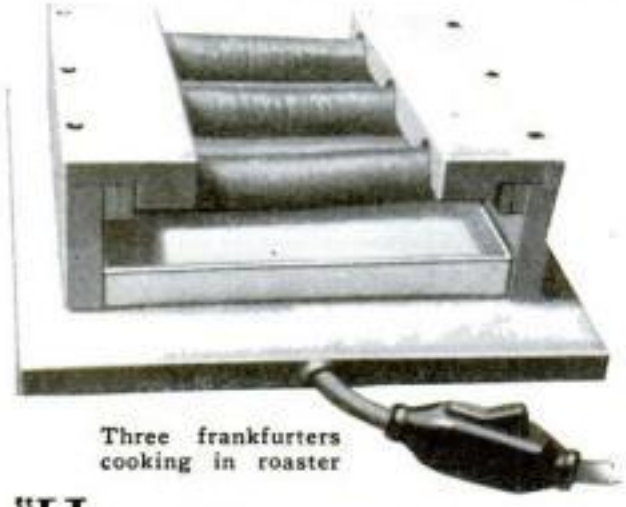
The drawings and, above, how feeder works

These pieces are fitted together, and the hole is bored and sawed in the slide. A piece of tin is then bent as shown and nailed to the back and slide.

The trigger may be built up of three ¾-in. boards, glued together. It moves up and down on two dowels fastened to the sides. The block, which pushes out the biscuits, is then worked to shape and fastened to the trigger with two flathead screws. A light coil spring screwed to the back automatically returns the trigger to a horizontal position.

Hold the parts temporarily together with a few nails while trying the feeder. When the mechanism works perfectly, it may be glued. The top is then hinged, and the bottom attached with screws. The feeder may be painted or stained and shellacked.—HERMAN HJORTH.

Homemade Electric Roaster Cooks Frankfurters Like Magic



Three frankfurters cooking in roaster

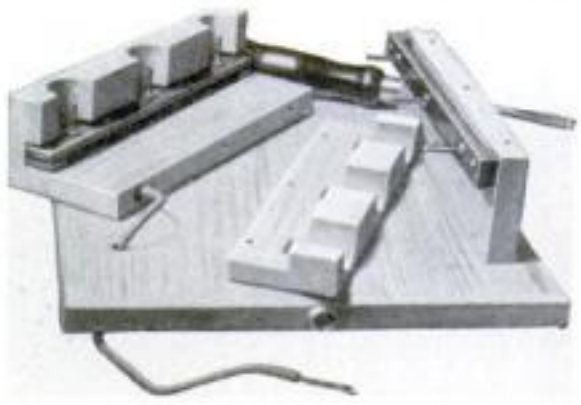
"HOT DOGS" are cooked as if by magic on this electrical weiner roaster. From one to three frankfurters are pressed on the pointed terminals of the device and the current is turned on. Because of the moisture in the weiners, the current flows through them and heats them. They start to swell within a few seconds, and in a minute or two are thoroughly cooked.

When used for cooking three weiners at once, the toaster draws about half as much current as an electric iron.

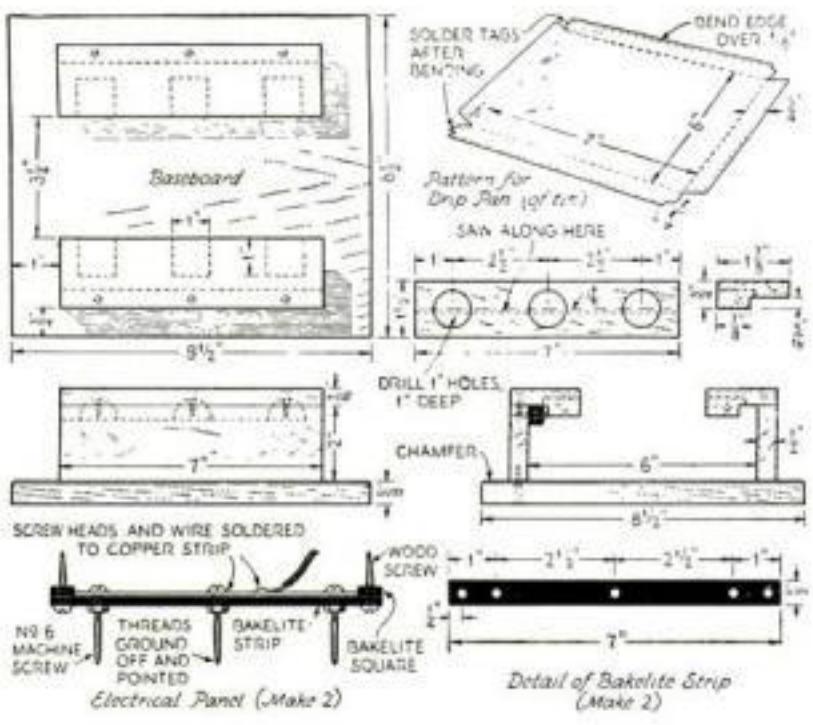
The materials required are as follows: 1 pc. wood ⅝ by 8½ by 9½ in.; 2 pc. wood ½ by 2 by 7 in.; 2 pc. wood 1½ by 1⅞ by 7 in.; 12 wood screws; 2 pc. bakelite, hard rubber, or other insulating material 3/16 by ½ by 7 in., and 4 pc. 3/16 by ½ by ½ in.; 6 No. 6 or 8 machine screws, 1 in. long, with nuts; 4 roundhead wood screws, ¾ in. long; 2 pc. thin copper ⅜ by 6 in.; 2 pc. insulated wire 6 in. long; cord, plug, and switch; 4 rubber-headed tacks; 1 pc. bright tin 7½ by 8½ in.

The first step in making the roaster is to prepare the two electrical panels. Cut out insulating strips as shown from bakelite, hard rubber, or other hard insulating material, and drill holes where indicated. Then cut out the copper strips, and mark and drill the holes. Prepare the machine screws by grinding off the threads at the ends and shaping them to a sharp point.

Insert the screws through the copper, then through the insulating material, and screw the nuts into place, thus holding the copper strip against the insulation. Solder the heads of the screws to the copper strip to insure a good contact, and solder a 6-in. piece of insulated wire to the end of each copper strip. Cut out the wooden pieces as shown, and mount the electrical panels on the uprights, using washers or blocks of insulating material to keep the copper strips from touch- *(Continued on page 77)*

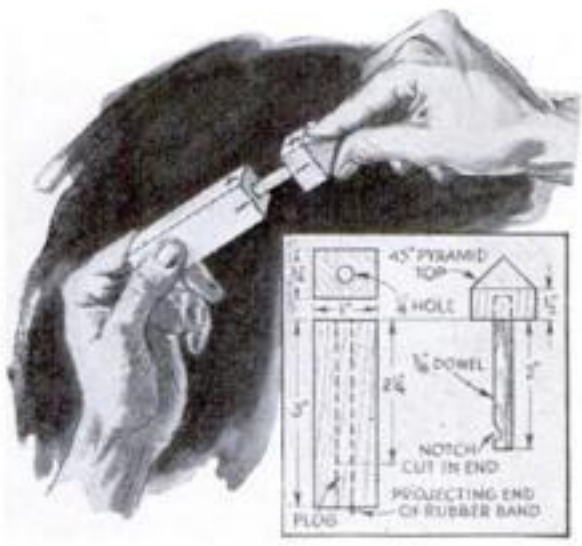


Method of constructing roaster. One photo shows it partly assembled, the other shows its underside



NOVELTIES

Are Comparatively Easy and Inexpensive
Certain to Arouse Your Friends' Curiosity



RUBBER-BAND TRICK FOOLS SPECTATORS

ILLUSTRATED above is a puzzle that will mystify the shrewdest of your friends. The plug, the projecting end of a rubber band, and the notch in the end of the dowel have no purpose except to mislead the uninitiated. It adds to the deception if the sides of both the block and the cap are numbered as if they had to be adjusted in some predetermined order.

To demonstrate, insert the dowel in the hole as far as it will go and twist the cap around two or three times. Withdraw the cap about an inch and, by squeezing the pyramid with the fingers, cause it to snap back again without moving your hands. In the meantime, tell your spectators that by certain twists you had caused the notch in the end of the dowel to engage a rubber band in the hole, and this is what caused the cap to snap back, as you have just demonstrated. Go through the twisting motions again as if to disengage the elastic, and let others try to hook the rubber band. They will follow your example and twist the cap and block in all sorts of ways to make the hook catch.—HI SIBLEY.

MODERN MAGAZINE RACK DIVIDED BY HOOPS

THIS modern magazine rack is a novel and useful addition to a set of porch furniture. It is equally suitable for year-round use in the living room.

Start with the two white maple ends, which will probably have to be glued up from two or more pieces. Cut them to shape and smooth the edges with a sharp scraper.

The walnut overlays for the ends are then cut out, and the exposed surfaces filled with dark paste filler before gluing these pieces in place. The two cherry overlays on each end are stained before assembling. The antiseptic known as "mercurochrome" is a satisfactory dye for this purpose. It is swabbed on with a tuft of cotton, and followed, when dry, with a coat of orange shellac. When gluing the overlays, apply the glue sparingly so that none will be squeezed out.

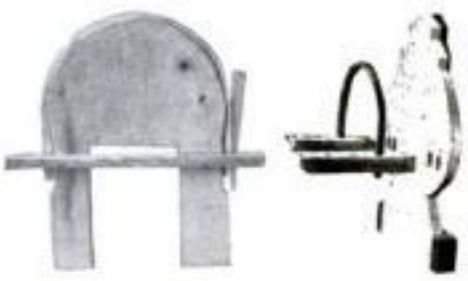
The base on each end is a simple job of mitering and gluing. The grain of these base pieces should run vertically.

Mortise and tenon the rails into the ends and cut all the square mortises for the hoops; then assemble these parts and prepare the hoops. The writer found that the sapwood of wild cherry serves admirably for this purpose. Cut the hoops to the required size.

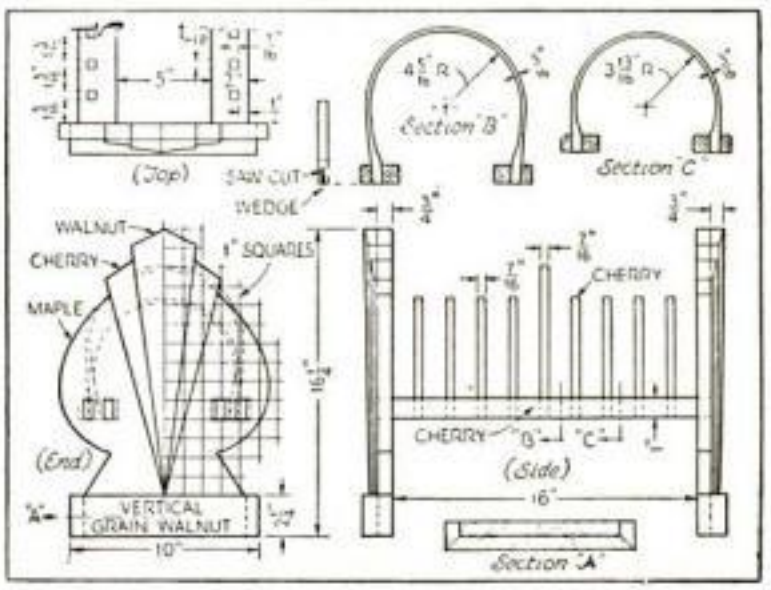
Of unique modern design, this magazine rack may be conveniently carried wherever needed

Cut out forms of the proper shape over which to bend the hoops. Place the hoops in boiling water for twenty or thirty minutes to make them flexible, bend them around the forms, and hold them in place as shown in one of the photographs. When they are thoroughly dry, assemble them by fitting them to the mortises in the rails and making a saw cut for wedging.

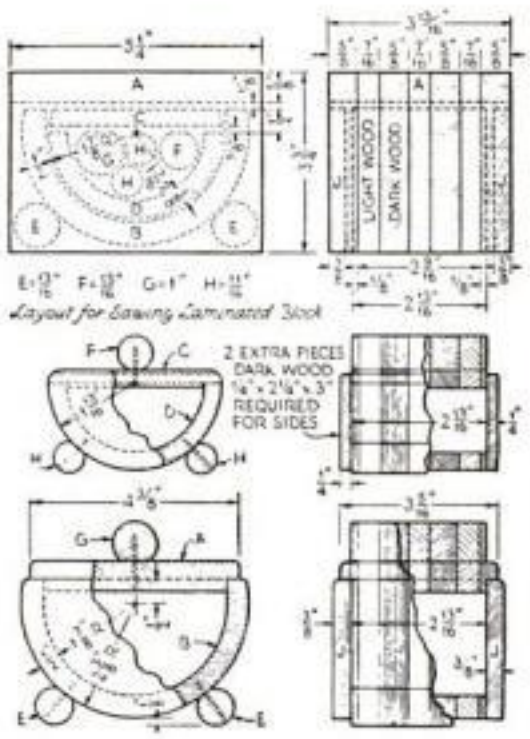
Finish this piece by applying two coats of white shellac, followed with a coat of good spar varnish.—ROGER MOYER.



At left above is shown one of the bending forms with a hoop clamped in place. The other photo illustrates the method of assembly, and the drawings appear at the right



CIGARETTE BOXES OF LAMINATED WOOD



Layout for Sawing Laminated Stock

Two boxes from one glued-up block

A SINGLE block of laminated wood, glued up from left-over scraps, provided practically all the material required for the two modern cigarette boxes illustrated. The block, 3¾ by 3 13/16 by 5¼ in. long, is glued up from three pieces of light-colored wood 7/16 in. thick and four pieces of ⅝-in. dark wood, with the light and dark alternating. Light mahogany with dark walnut, cherry with selected white maple or holly, and rosewood with lacewood are suggested combinations. Cut the wood slightly larger than shown and, after gluing, true up the block to about the dimensions given. Take especial care to get the four long sides square with each other.

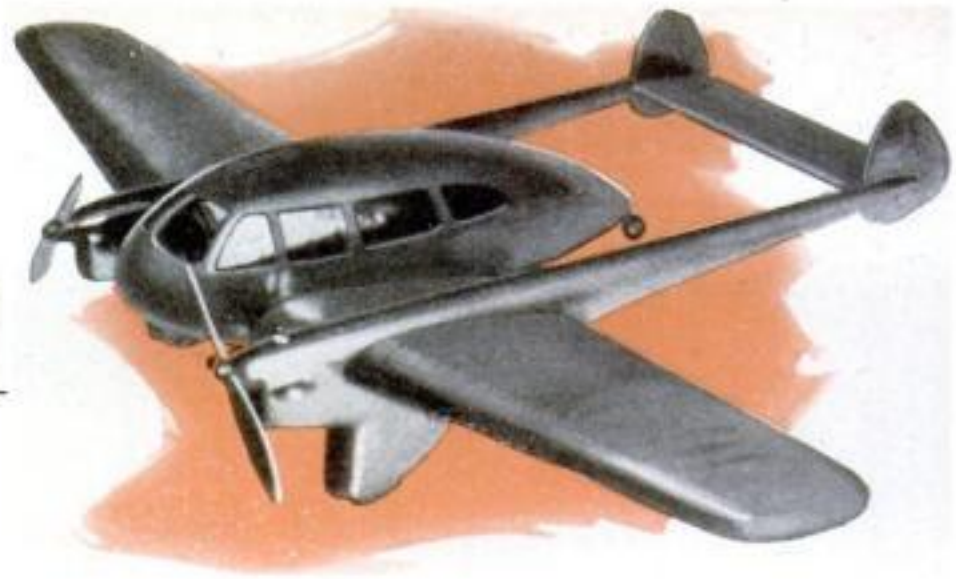
Across the laminations slice off the piece *A*, ⅝ in. thick, from which the lid of the larger box is to be formed. Then, parallel with the laminations, slice off the ⅜ in. thick sides *J*. Carefully plane the remaining block square. See that the laminations are kept central and parallel with the sides.

With a sharp pencil lay out carefully the various parts for band sawing as shown on the drawing. Saw them out in the alphabetical order of their designating letters. Note that one cut shapes the inside of *B* and the outside of *D;* also that the small feet and handles are incomplete circles in *(Continued on page 77)*

NEW

Streamline Plane Model

Only fifteen parts are required for constructing this miniature Crusader



By DONALD W. CLARK

ONE of the most highly streamlined designs among the new airplanes is the four-place, twin-engined, low-wing cabin monoplane known as the "Crusader." This plane, according to the manufacturer, can take off in eight seconds, has a high speed of more than 200 m.p.h., can fly nearly 150 m.p.h. with one engine, and lands at 55 m.p.h.

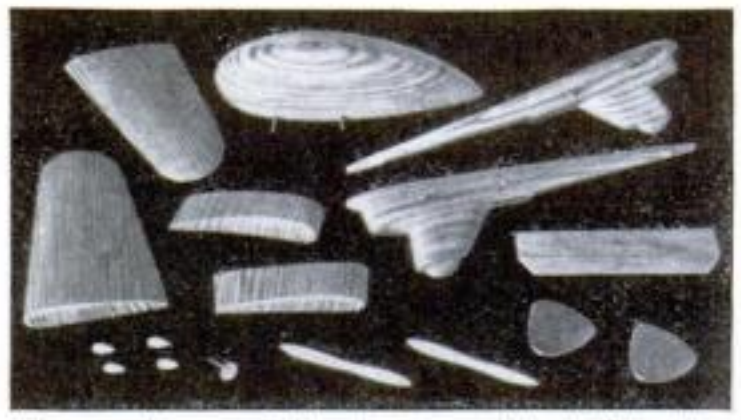
The cabin resembles closely the body design of the modern streamline automobile and is just as roomy and comfortable. It is about 4 ft. wide and seats four people with ease. Entrance is made through a door on the right side.

The scale of our model in comparison with the full-sized airplane is ⅜ in. equals 1 ft., like the majority of models previously described in this series. Fifteen simple units are required, and these are assembled easily with eight metal pins and four common pins. The only cement or glue needed is to hold the four hood caps in place.

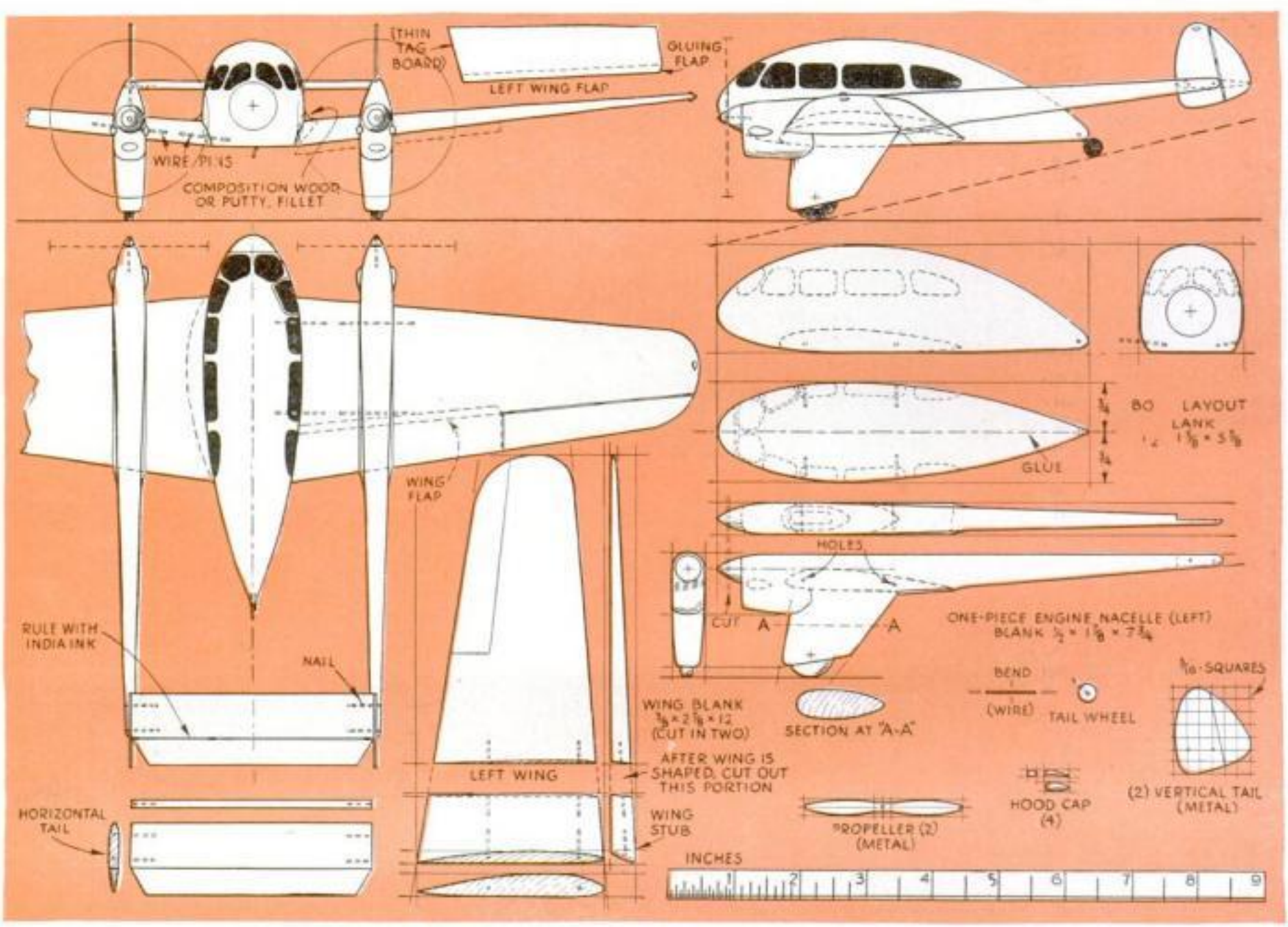
To make the wings, cut the blank large enough to take in both the right and the left wing, and shape completely while in one piece. Cut in two and then, from each half, saw out a ½-in. section as shown on the wing drawing. The removal of this portion of the wing allows the engine nacelle to be set in without changing the taper of the wing.

Each of the engine nacelles is designed to be shaped in one piece, but the wheels can be made separately and glued on, if desired. After the tapered nose has been shaped, the cone at the end forming the propeller hub should be cut off carefully. Before cutting it, however, drill a small hole to take a common pin for mounting the propeller.

As a preliminary *(Continued on page 83)*



The complete set of shaped parts used in building the Crusader model. The drawings and scale appear below



The saws are hung by pushing them between the rubber clips (shown large for clearness)

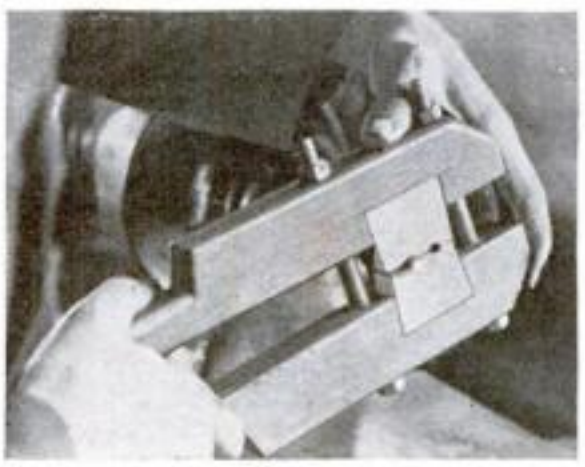
LAYING a saw down each time it it used is hard on the saw teeth, especially if the bench is crowded, as mine generally is. Reversing it so as to hang it up by the handle takes time, and sweaty hands soon cause rust spots to appear on the polished steel. A better way is to make quick-acting rubber clamps or hangers, as shown.

The rubbers (two for each saw) can be formed from the shoulder sections of a worn-out auto tire or from rubber heels (but look out, when cutting heels, for the tiny steel washers that are molded around the nail holes). Use a sharp knife and wet it for each cut. For the baseboard, use ⅜- or 1-in. stock. When mounting the rubbers. drive nail *B* last, and press the points *A* of the rubbers together firmly.

Mount the completed hanger above the bench, high enough so that the saw handles are convenient to grasp. When replacing a saw, shove the end of the blade up between the rubbers—it will find its own opening—and push it up so that the end is 2 or 3 in. above the rubbers. It cannot fall if the rubbers are properly set. To release, grasp the handle and pull out toward you, not downward. It comes out so easily that you will wonder what held it up.

A refinement is to make the baseboard longer than your longest saw and cover the part below the rubbers with any suitable cloth, slightly moistened with a good oil. The teeth of the saw will keep sharp much longer, especially in the case of saws that are seldom used. Microscopic rust on the cutting teeth of unused saws dulls them almost as much as though they were being used, if they are not well protected, particularly during damp weather or in a damp shop.—WILLIAM R. SPRAGUE.

QUICK-ACTING SAW RACK HAS RUBBER HANGERS

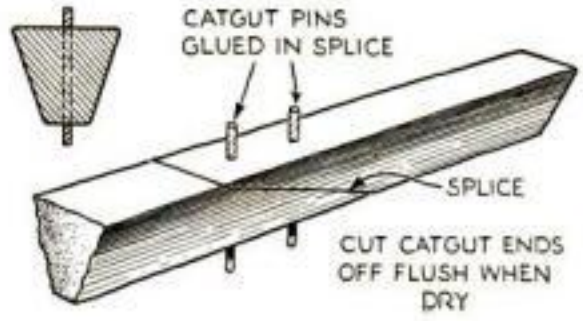


CONVENIENT HOLDER FOR LEAD LAPPING BLOCKS

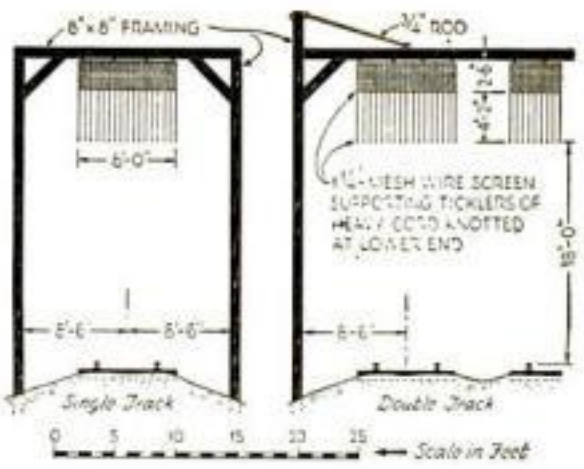
ALMOST every mechanic, amateur or professional, who does lathe work has at times to reduce, or accurately size, cylindrical pieces of hardened metal by lapping. Even unhardened pieces may often be more accurately or conveniently brought to exact size by lapping. Sometimes wooden forms coated with a mixture of oil and fine abrasive are used as laps, but generally lead laps are more satisfactory.

A handy way to hold lead blocks used in lapping is to make a hardwood frame as shown above. It is dovetailed so that the lead blocks may be pressed in. Two long bolts hold the frame together, the nuts being loose enough so that adjustment may be made with the fingers. If wing nuts are at hand, they are even better. Coil springs placed on the bolts between the two parts of the frame serve to keep the lead lap open until the handles are pressed together. Any size hole may be made in the lap to suit the work in hand; and, when too badly worn, the lead blocks may be melted and recast. A lap of this type enables one to do rapid work with a minimum amount of whatever oil-mixed abrasive is used.—A. E. G.

SMALL V-BELT SPLICES PINNED WITH CATGUT



ADDED strength may be had in splicing V-belts by gluing pins of catgut (such as tennis-racket strings) as shown above after the usual diagonal splice has been made and allowed to dry. The ends of the pins are then cut off flush with the surface of the leather. In small belts it is best to use only one pin.—ROGER M. JOHNSTON.



MINIATURE TELLTALES FOR MODEL RAILWAY

FOR the model railway system that boasts a tunnel or any other overhead obstruction, it is desirable to supply miniature telltales. Rules and regulations demand that telltales to warn brakemen atop freight trains be provided at all places where the clearance is less than 21 ft. (in some states, 22 ft.). Look over your system and see if this safety feature has been neglected.

The drawing above shows telltales for both single and double track layouts. If your road is built to a scale of ¼ in. to the foot, the framing for either the single or double track telltale should be made of slender strips of wood. For the smaller scales, use square wire (bus bar, found in old radio sets, is ideal) and make the framing all in one piece with the corner braces soldered in place.

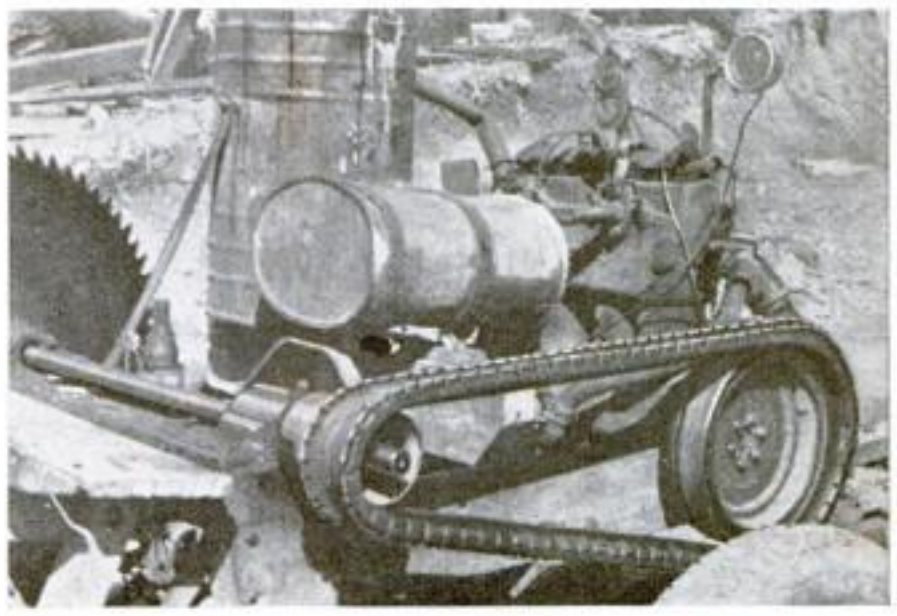
The wire screening that supports the ticklers should be made of some open weave cloth. Cross-stitch canvas, a stiff, lightweight cloth, is suitable. A piece somewhat larger than the required screen should be painted or stained black and then cut to size. The lower edge of the cloth is frayed out and every fourth or fifth thread left longer than the rest to represent the ticklers. Paint the frame a dark brown to look like creosote.

Place the telltales not less than 100 ft. (to scale) from the tunnel or bridge it protects. The ticklers should extend at least 6 in. below the obstruction.

Full-size dimensions are shown on the drawing, also a scale in feet so that the telltales may be reduced to any desired scale.—J. W. CLEMENT.

OLD TIRE SERVES AS HEAVY-DUTY BELT

THE short-center, heavy-duty drive belt illustrated at the right is nothing more than a discarded automobile tire casing. Service of this kind on a cut-off saw is very severe on any type of belt, especially when used on such short centers, yet the improvised belt has stood up well and given satisfaction for two years. It will be noted that no idler is used in this installation and that the pulleys are flat.—R. H. PICKENS.



For two years a belt improvised from an old tire casing has driven this circular saw. The short drive makes this service particularly severe

PLANS FOR BUILDING A Four-Treadle

Specially designed for home use, it will weave cloth up to thirty-eight inches wide in an endless variety of patterns

HAND WEAVING, one of the principal domestic crafts of early Colonial days, is coming to the fore as a hobby. An increasing number of requests have been received from readers for information on building a high-grade loom. To answer these questions, we asked Mr. Gottshall, who has built many looms, to prepare a set of plans.

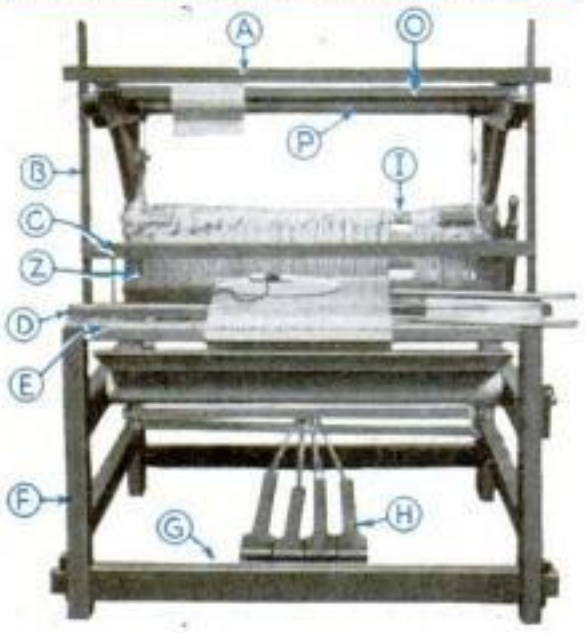


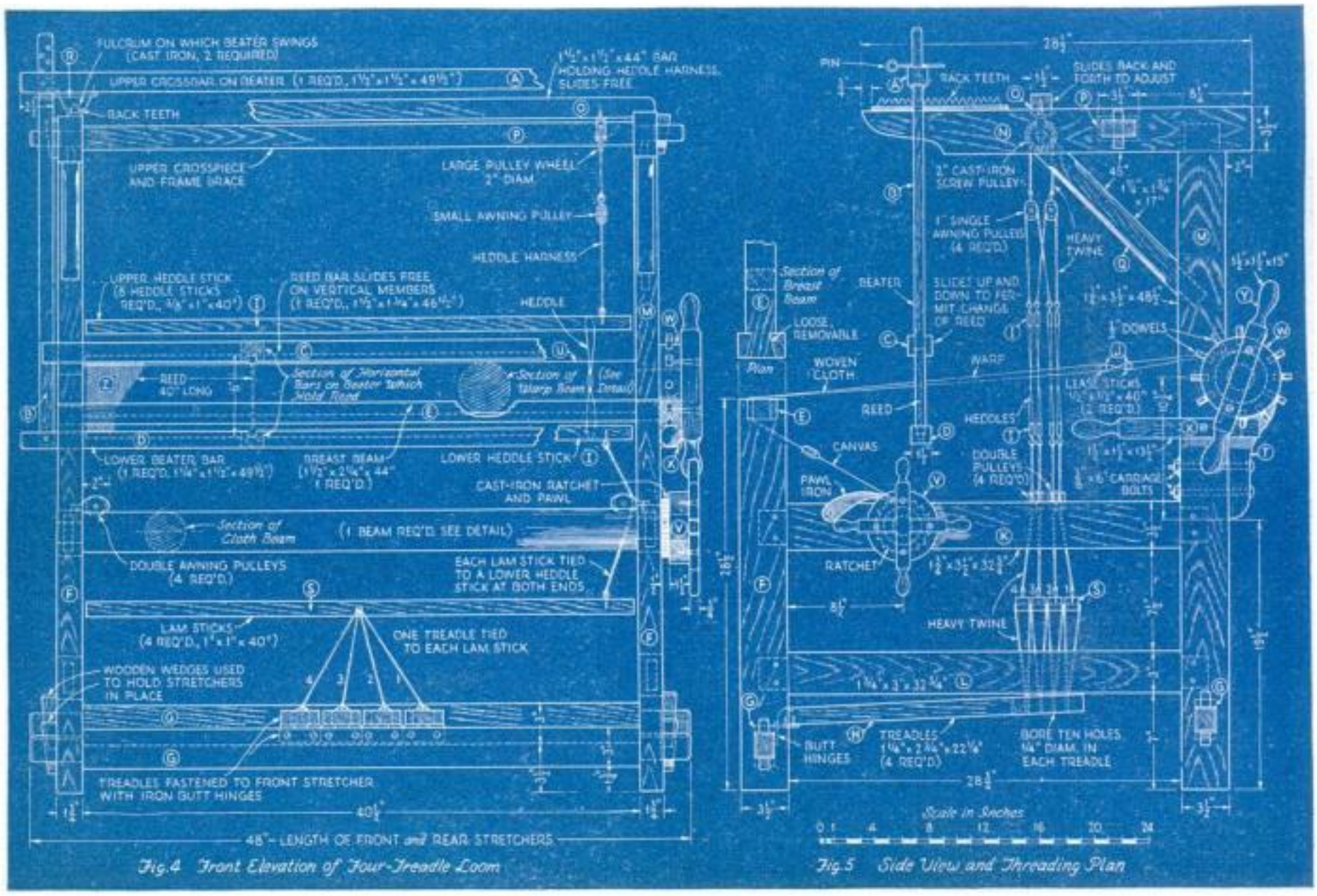
Fig. 1. Photo of the finished loom from the working position. The more important parts are lettered to correspond with the drawings

INTEREST in the art of hand weaving is rapidly being revived, and justly so, for its value as a handicraft from the artistic standpoint can hardly be overestimated. On a homemade hand loom such as the one shown, Colonial coverlets, throws, runners, table linen, hand bags, rugs, and numerous other articles may be woven, and a great variety of beautiful patterns may be worked out. The covering material for the wing chair described in a previous issue (P.S.M., Dec. '34, p. 68) was woven on this loom, which is large enough for weaving cloth 38 in. wide.

In order that the construction may be more clearly understood by those who wish to build the loom, it will be necessary to explain briefly the principles involved in its operation.

The warp threads, running lengthwise of the cloth, are placed on the loom in such a manner that certain groups of threads may be separated from others, thus allowing the weft threads, which run crosswise, to be woven into the cloth by means of a shuttle. The separating of the groups of thread is called a shed, and is clearly shown in Fig. 2, where the shuttle is about to be passed through the opening of the shed. The shed is made by depressing one or more of the treadles (marked *H* on the drawing) to which the harness of the loom is tied. The harness consists of ropes, pulleys, sticks, and heddles, of which the heddles are the most important part. It is by raising some of the heddles and lowering others that the shed is formed.

Heddles are made by tying two-ply, waxed cotton warp thread into loops, having an eye in the center, as shown in Fig. 4. The heddle, when tied, is about 9 or 10 in. long, and the eye in its center is not more than an inch in length. It is important to make every heddle alike. To do this, drive four nails into a piece of wood, around which the knots may be tied, thus making them uniform. There must be one heddle to each warp thread, which is threaded through the eye of the heddle. Since there are four heddle frames in this loom, each tied to a different treadle, sheds consisting of various combinations of warp threads may be formed by depressing one or more of the treadles. The pattern of the cloth is partly determined by the manner in which the threads are grouped on the heddle frames, and partly



Hand Loom

By FRANKLIN H. GOTTSHALL

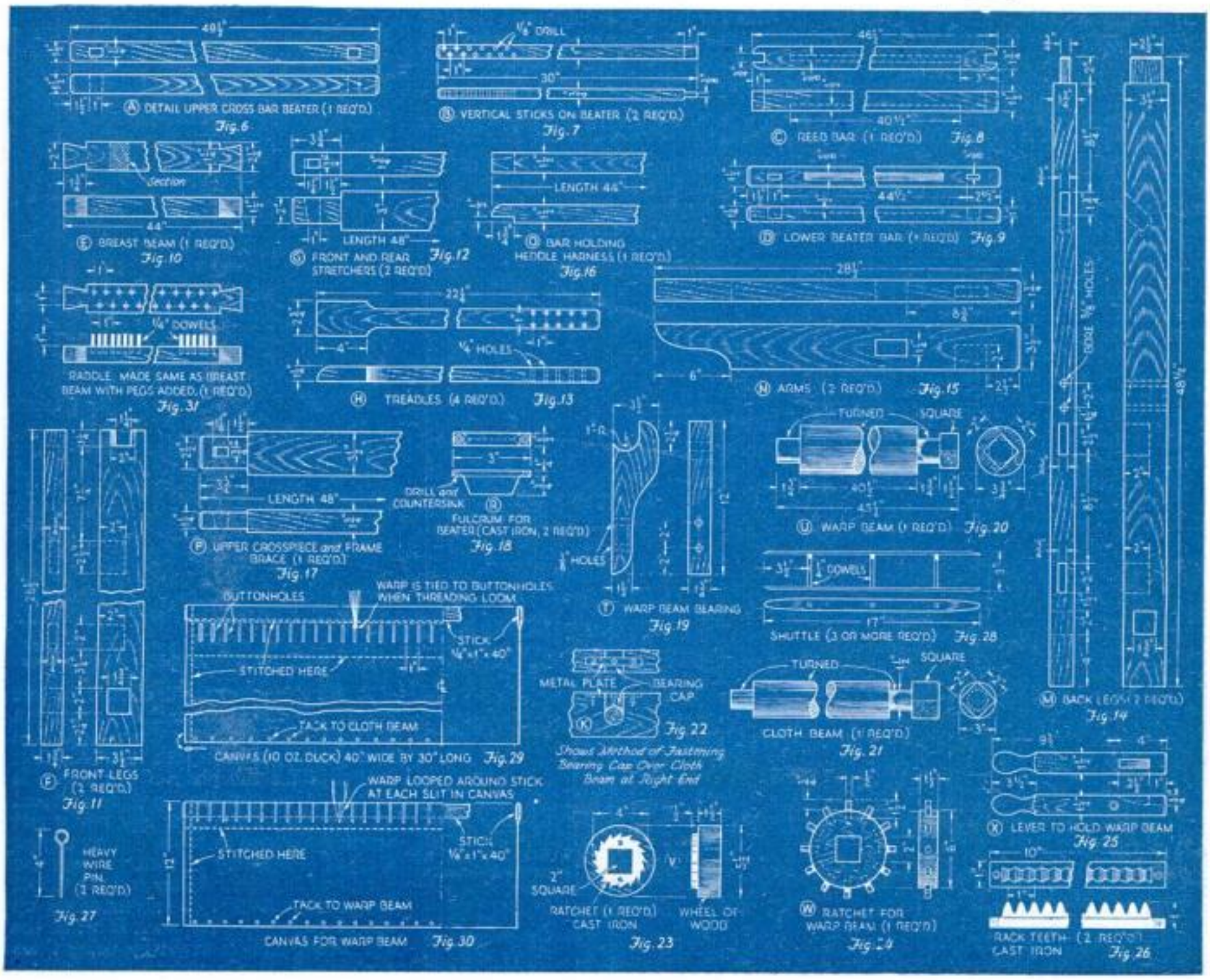
Fig. 2. Mrs. Gottshall weaving on the hand loom

by the order of treading when the cloth is being woven.

As the weft threads are woven in, they are packed as tightly as desired by means of the beater. The beater is a frame holding a series of wires known as a reed *(Z)*, which beats the thread tightly into the cloth, thus completing the weave. One or more reeds are needed, and it is desirable to have at least two. If only two are bought, one should be a 17-dent reed, that is, a reed having 17 wires to the inch. The other should be a 24-dent reed. Since these would be very difficult to make, and as they are inexpensive, they should be purchased from a firm where weaving materials are sold. As the cloth is woven it is rolled up on the cloth beam.

With this explanation of the principles of weaving, it is hoped that the construction of the loom will become clear upon examination of the drawings and photographs.

To make the construction of the loom as understandable as possible, the author has indicated the various members with letters, and named many of the parts directly on the drawing. The reference letters are identical on *(Continued on page 92)*



MAKING SHELVES FOR MASONRY GARAGE

Portable shelving easily taken down

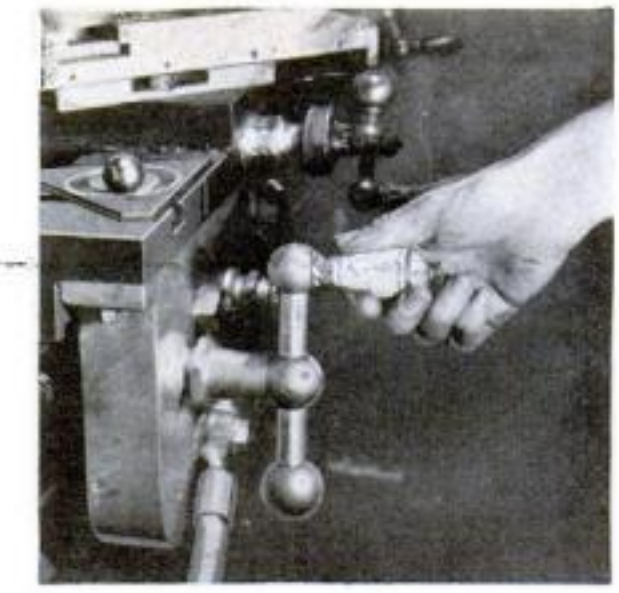
IF YOU have an attached garage and don't feel equal to fastening shelf supports to the masonry walls, here is an easy way to make portable shelving that stands by itself. You will need two dressed planks, each 12 in. wide and at least 15 ft. long; 5 ft. of 2 by 4-in. wood; 4 ft. of 1 by 2-in. wood; two 10-in. iron shelf brackets with screws; and twelve 1½-in. flathead screws.

If the garage is, for example, 10 ft. 1½ in. wide, cut off 10 ft. from each plank, leaving two end supports, each 5 ft. long. Cut the 1 by 2-in. stuff into four 1-ft. lengths. Screw one of these across one of the 5 ft. supports, 3½ ft. from one end, and another 1 ft. above it. Do the same with the other support.

At the center of each 10-ft. shelf, cut a 2 by 4-in. notch. Screw one bracket 3½ ft. from one end of the 2 by 4, and fasten the other bracket 1 ft. above it, both on the 4-in. face of the timber.

Set the side supports against the garage walls and put the 2 by 4 in the center of the back wall, with brackets pointing outwards. Commencing with the lower shelf, hammer both shelves down on their respective crosspieces, with the center notches fitting around three sides of the 2 by 4 and with the brackets supporting the center of the shelves. The whole affair can be made such a tight fit that it will be unnecessary to nail down the shelves or fasten the end supports.

Any difference in the width of the garage may be compensated for by making the shelves shorter or longer. A few cup hooks may be screwed under the lower shelf to provide for hanging brushes and cleaning cloths, and a shallow ten-cent baking pan may be used to hold oilers, measures, and grease guns.—E. T. KEYSER.



SHAVING TUBE IMPROVES SOLID CRANK HANDLE

A SOLID crank handle on a lathe or other machine can be made more comfortable to use by the simple expedient of slipping an empty shaving-cream tube over it, as illustrated above, after the tube has been cut off to the same length as the handle. Shape the tube to conform to the handle and oil it by removing the cap. It is surprising how freely it turns on the polished handle. The effect is the same as if the crank handle itself were of the revolving type.— HALVOR ANDERSON.

SCREWS DRIVEN QUICKLY WITH ASSEMBLING JIG

Jig with small motor in place on a locating plate ready for driving the four end screws

A SHOP making small electric motors has a screw-driving assembling jig that can be applied to numerous other jobs. The screw driver, which is used to set the four screws of the end plate of the motor, is carried in an arm that may be adjusted up or down or swung to any radius and securely clamped in place. On some jigs, a small coil spring is used between the handle of the screw driver and the top of the arm for holding the screw driver up out of the way as the work is set in the jig. Much time is saved by using these devices.—A. E. GRANVILLE.

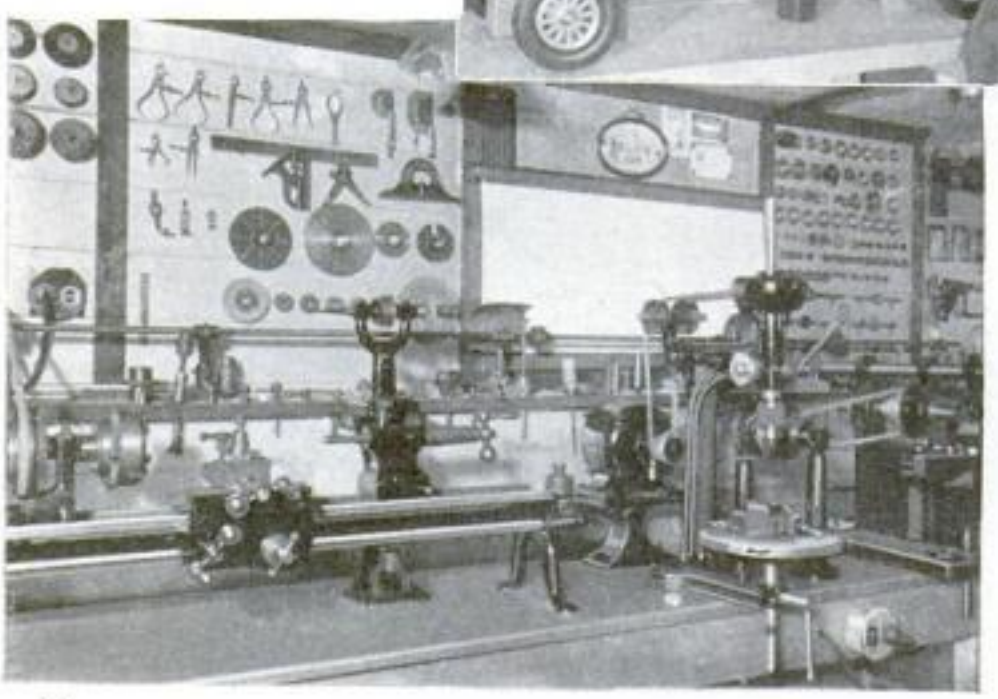
NEAT LAYOUT FOR HOME MACHINE SHOP

MANY photographs of well-arranged small shops for woodworking have been published in past issues, but here is a home machine shop of exceptional compactness and neatness. Its owner is Herbert Atkinson, of New Bedford, Mass.

Note the orderly arrangement of tools and accessories on wall panels. Close inspection will also show a long rack for much used tools running the entire length of the machine bench immediately below the line shaft.

For ten years Mr. Atkinson has been working on a model of a 1916 Ford. It is 25 in. long, exactly one quarter the size of the original car. The patterns and parts were all made by him in this basement shop, and their assembly is now well under way.

Herbert Atkinson with chassis of a one-quarter working scale model of a 1916 Ford car which has required ten years to build



The machines in Mr. Atkinson's basement shop. Out of sight at the left is a workbench and a large vise, and at the right is the bench where his model and other work in progress are kept

"They don't get your Wind" ATHLETES SAY

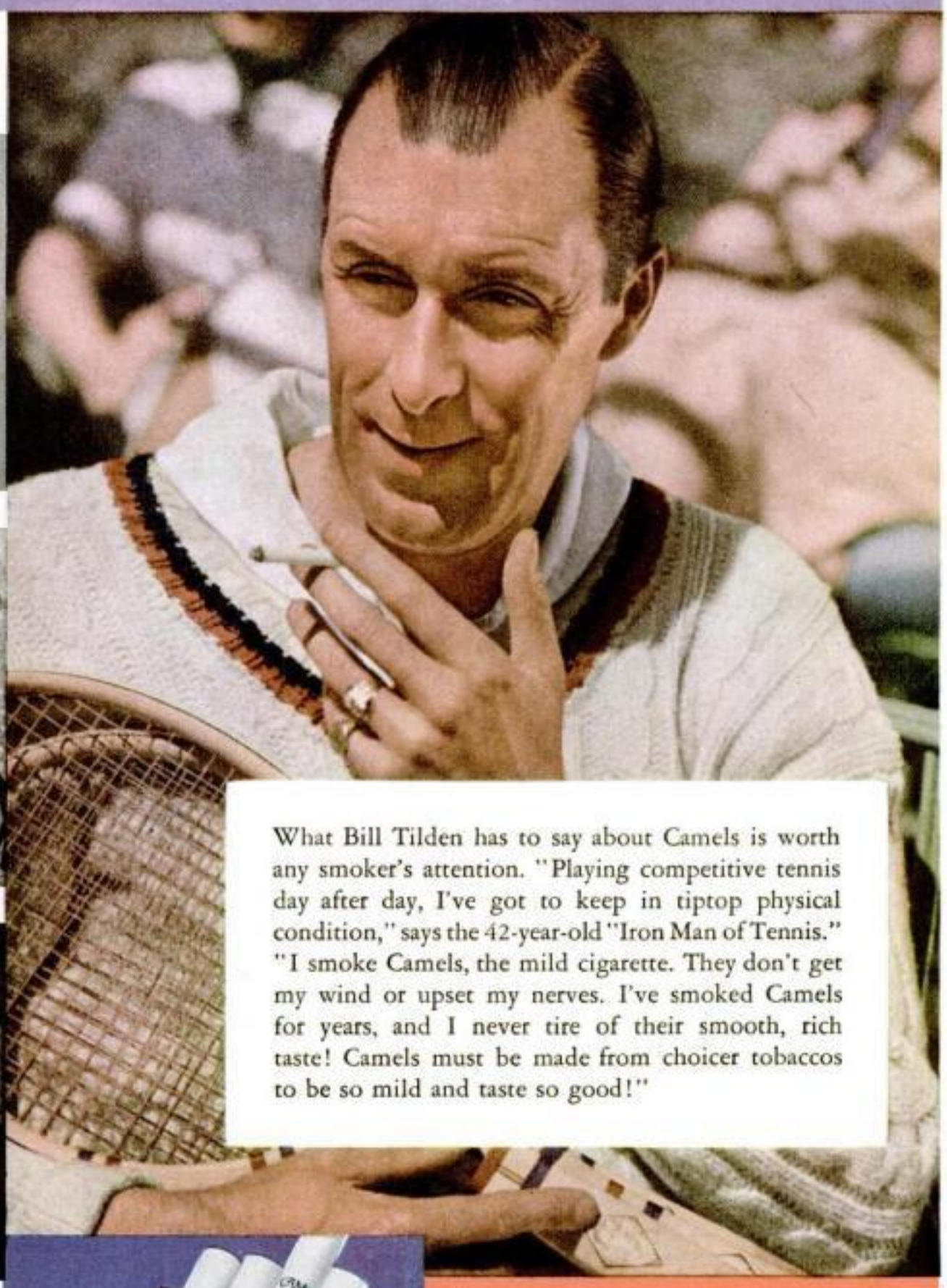
YOU'LL LIKE THEIR MILDNESS TOO!

HOMEMAKER—Mrs. J. B. Feeley

ACCOUNTANT—C. A. Petersen

WRITER—Eileen Tighe

REPORTER—Dick Hungerford



What Bill Tilden has to say about Camels is worth any smoker's attention. "Playing competitive tennis day after day, I've got to keep in tiptop physical condition," says the 42-year-old "Iron Man of Tennis." "I smoke Camels, the mild cigarette. They don't get my wind or upset my nerves. I've smoked Camels for years, and I never tire of their smooth, rich taste! Camels must be made from choicer tobaccos to be so mild and taste so good!"

Costlier Tobaccos!

● Camels are made from finer, MORE EXPENSIVE TOBACCOS—Turkish and Domestic—than any other popular brand.

(*Signed*) R. J. Reynolds Tobacco Co., Winston-Salem, N. C.

It takes 25 operations

TO FINISH ONE FORD VALVE

EACH Ford valve requires twenty-five separate operations from the time work starts on a rough valve until it is ready for use. That is a surprising number of operations for such a simple looking part, but typical of the care used in manufacturing all Genuine Ford Parts.

Ford valves are made in Northville, Michigan, in one of fourteen Ford single-department plants located within fifty miles of the main Ford plant in Dearborn.

The stems of the rough valves first receive two preliminary grinding operations. Then they go through a furnace where the heads are brought to a red heat. Next, automatic fingers place them in a huge machine where a ram strikes the red-hot heads. This operation refines the grain structure in the head, straightens it, and forms the valve seat.

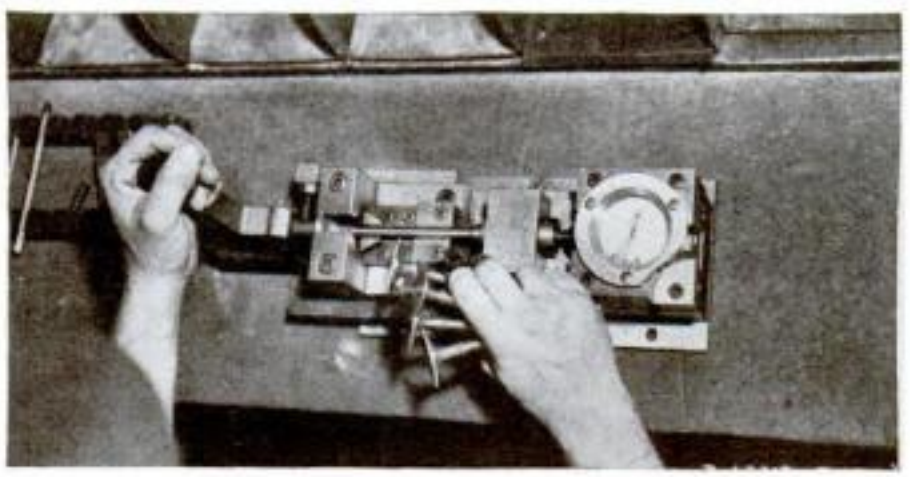
Valves then pass through other grinding, machining and polishing operations. Each stem is ground five times for greater accuracy and smoothness. Inspection gauges keep a constant check on the precision of machines.

In spite of this care, each Ford valve is subjected to most rigid final inspection. Amplifying gauges check the stem for roundness within two ten-thousandths of an inch. Similar gauges check diameter.

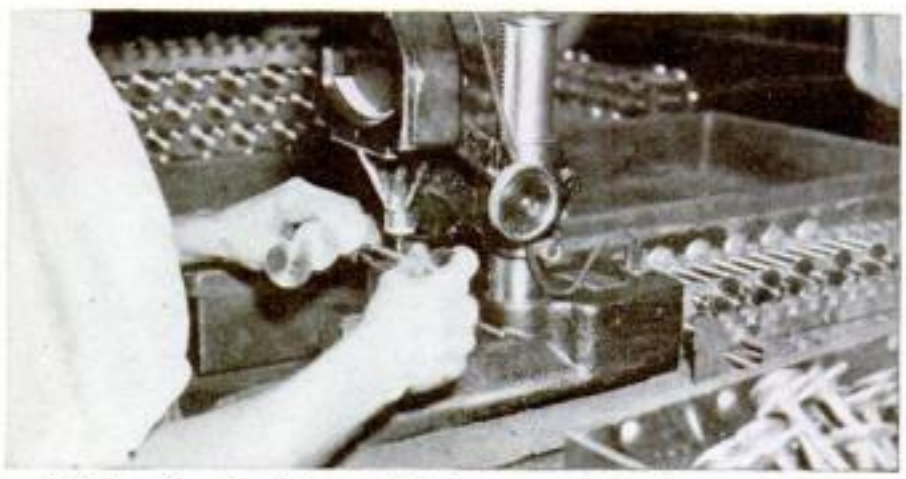
Other inspection equipment indicates the slightest "run out" of seat and checks stem end for squareness. Then the valves go into a constant temperature room where they are inspected for length.

While the difference in length of a valve stem under normal temperature changes is very slight, measuring valves in a room where temperature is controlled indicates the precautions taken in manufacturing Ford parts. That is why it pays to insist on getting Genuine Ford Parts for your Ford car or truck.

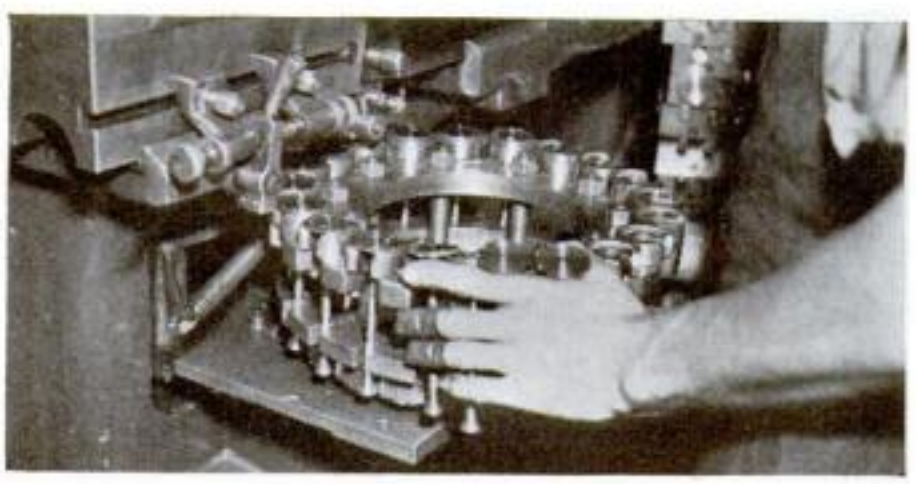
A grinding room in the Ford valve plant in Northville, Michigan



Length of valve is checked under same spring pressure as in engine



Optical and mechanical magnification gauges check valve stem diameter

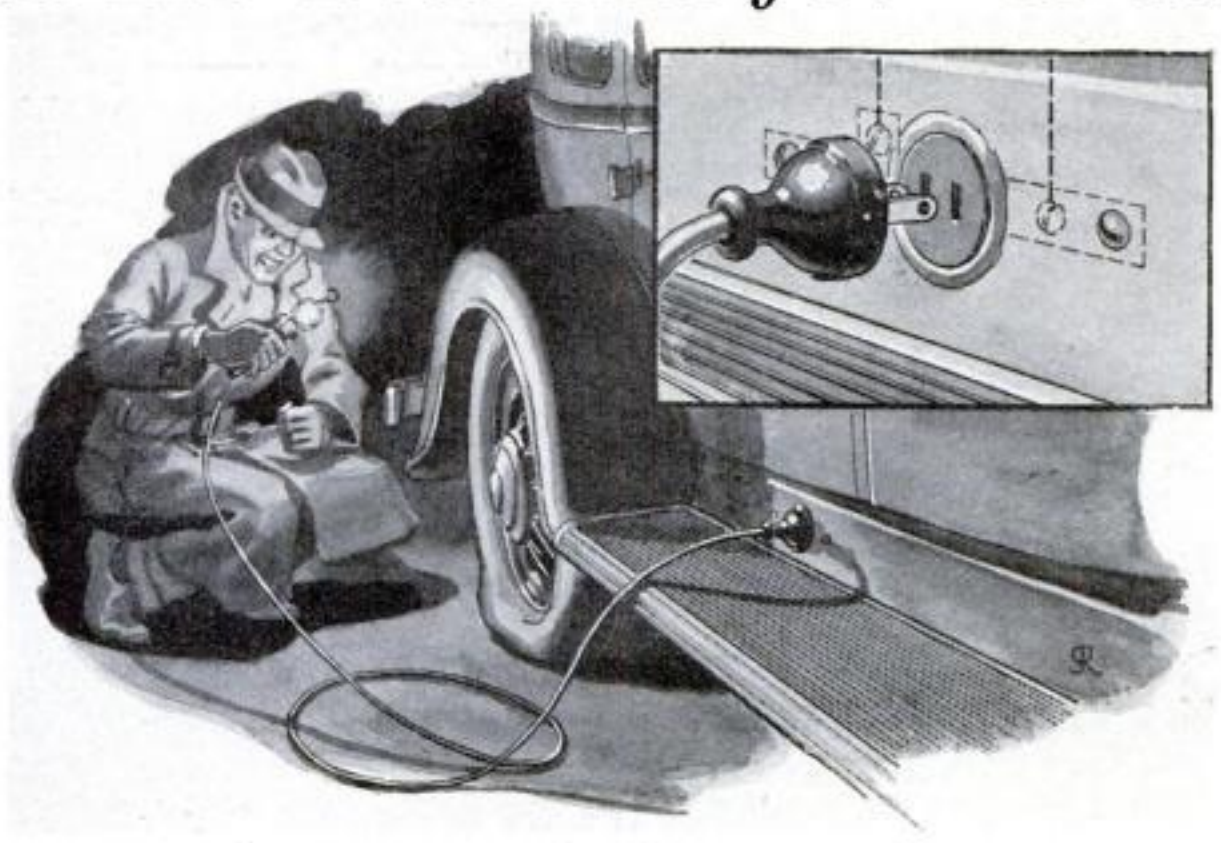


Rolling the Ford name on valve to protect you against substitution

FORD MOTOR COMPANY • DEARBORN • MICHIGAN

Six Kinks *for* Car Owners

Motor-Wise Readers Pass Along These Time-Saving Ideas That Simplify The Problem of Keeping Your Automobile In First-Class Condition

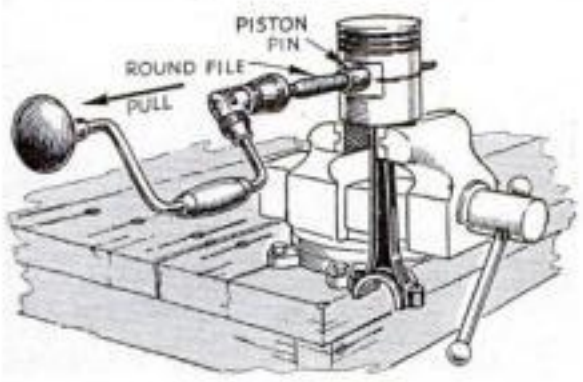


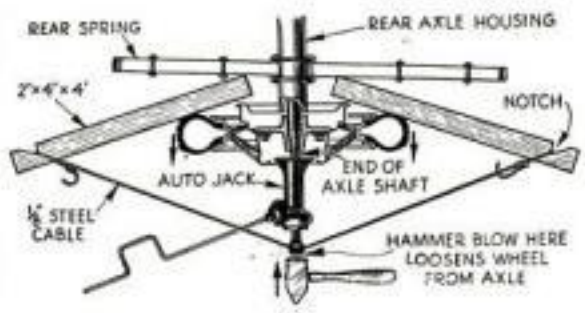
Plug-In System for Emergency Lamp

A HANDY outlet receptacle for a portable trouble lamp can be installed easily in one of the rear-spring inspection holes located on the splash pans of most older-model cars. Bolted in place and connected into the lighting circuit, it will always be ready to receive a standard plug attached to the end of the trouble-light wire. If desired, an outlet can be placed on each side of the car. On cars having no inspection holes, the receptacle can be mounted under the dashboard, on the motor cowl, or on the floor boards, as convenience may dictate.—W.B.E.

Removing Wrist Pins

INSTEAD of trying to knock a stubborn wrist pin loose from its piston, use an ordinary rat-tail file in the manner shown. Simply clamp the piston in a vise, fasten the file in a brace, and insert the file tip in the hole in the wrist pin. A pulling and turning motion will draw the pin out.—E.N.



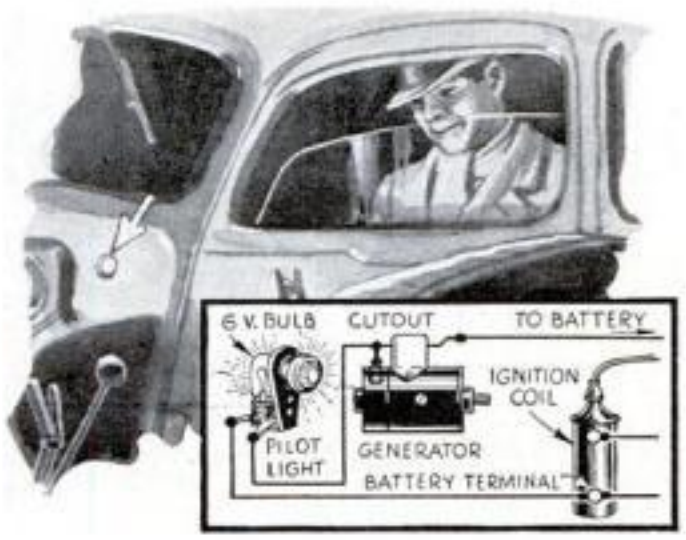


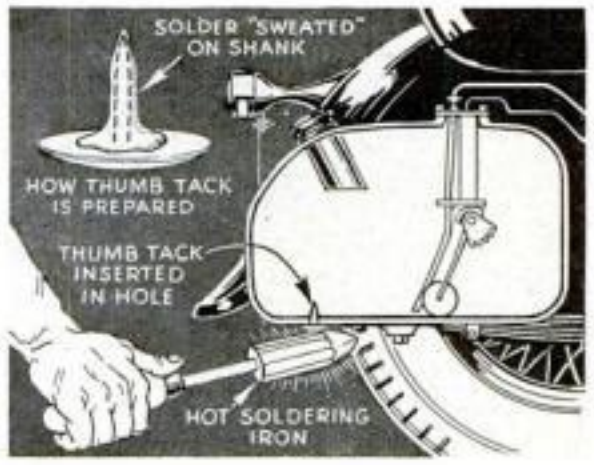
Pulling Balky Wheels

AFTER trying, without success, several of the approved methods of removing wheels, I devised the rigging illustrated. It consists simply of two long pieces of lumber (two-by-fours) notched at their outer ends, a length of cable, and a regular tire jack. Due to the leverage of the boards and the power of the jack, a single hammer blow freed the wheel.—T.W.B.

Pilot Light Warns of Ignition Trouble

BESIDES indicating whether or not the generator cutout on your car is operating, the pilot-light arrangement shown also serves as an ignition-key signal. Lighted with the motor running, it shows that the ignition is on but that the generator cutout is open. Not lighted with the motor running, it indicates that the generator is operating and the cutout is closed. Because it also glows when the ignition is on with the motor not running, it provides a good telltale that will serve to remind you that your ignition switch is still turned on.—P.C.B.





Easy Gas-Tank Repair

BY MAKING use of an ordinary thumb tack, pin holes in the bottom of a gas tank can be soldered easily without removing the tank from the car chassis. First drain the gasoline and clean a spot around the hole. Then flux the spot, take a brass thumb tack, and, after fluxing the tack and sweating solder on the shank, insert the shank in the hole and hold it there with the tip of your soldering iron. Finally, replace the iron with a screw driver and hold the tack in place until the solder hardens.—N.E.

Shirt-Sleeve Protectors

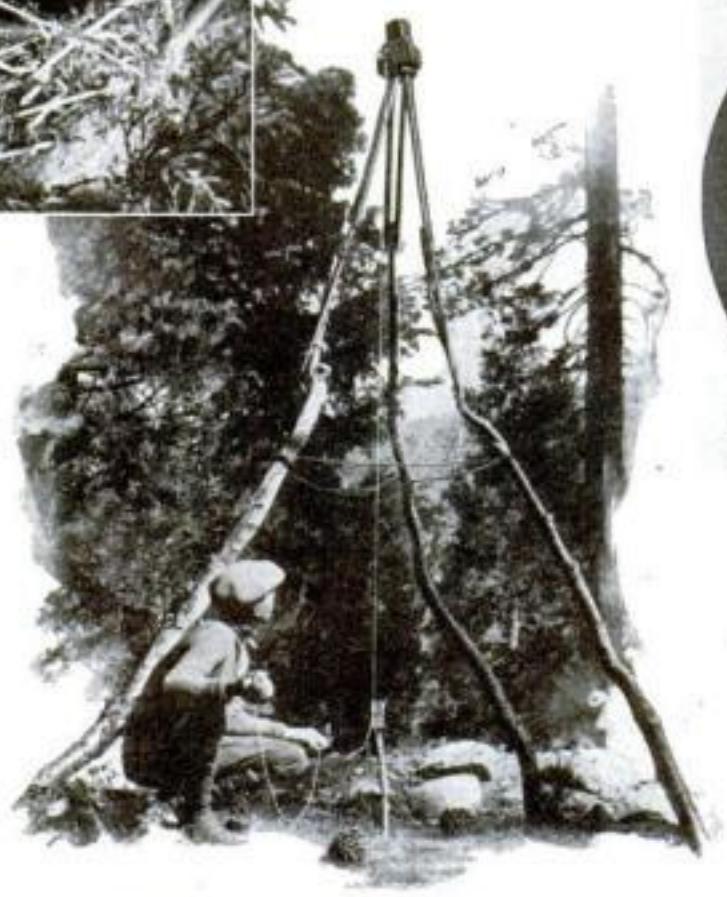
ROADSIDE repairs and clean shirt sleeves are a poor combination, even when the car owner takes the precaution of rolling up his sleeves. A simple solution is to add a pair of emergency sleeves to your tool kit. By cutting a pair from an old shirt and adding elastic tape at their tops and bottoms, you can provide yourself with a pair of sleeve covers that can be slipped into place easily. If preferred, a regular pair of fabric arm guards can be purchased for the purpose.—D.J.A.J.

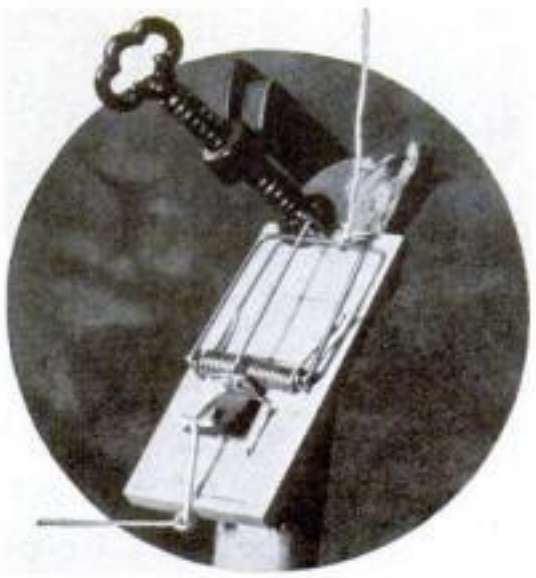
Mousetrap Photography

A SURE-FIRE WAY TO SNAP CLOSE-UP PICTURES OF BIRDS AND ANIMALS IN THEIR NATURAL SURROUNDINGS

By RICHARD W. ROLPH

California mocking bird snapped building her nest. The shutter was released by the mousetrap method from a spot fifty feet away





The mousetrap ready for springing the shutter and, left, the complete set-up

MOST amateur photographers at some time or other have an overwhelming desire to make close-up photographs of wild animals or birds. Perhaps it is a bear or deer in one of the national parks, or a squirrel in a nearby wood lot, or just an interesting bird's nest out of reach in your own back yard. It is very easy to make a good close-up photograph of any subject that will not allow you to approach it merely by using some string and an ordinary mousetrap to operate the shutter of your camera.

One of the accompanying illustrations shows a mousetrap photographer preparing to take a picture of a bird's nest. Exactly the same method could be used, of course, to get pictures of birds in a garden bird bath or entering a bird house.

In this case, the camera was first focused upon an object on the ground about the size of a bird's nest and set at stop F/16, shutter speed 1/25 of a second. Panchromatic film was used. The tripod legs were next strapped to three long poles, and a string was tied to the camera shutter release. This unusual tripod was then raised to the correct focus or distance from the camera to the nest.

The string from the camera shutter release was tied to a mousetrap, which was clamped to a stake driven in the ground; and the end of another long string was tied to the bait hook after being passed through a screw eye in the end of the trap as shown in the detail photograph. The trap was set in the usual way. With this arrangement, a light pull on the long string will spring the mousetrap, which in turn pulls the camera shutter release and thereby automatically takes a picture, even though you are hundreds of feet away.

Here are a few tips for the amateur to remember when making a set-up of this kind. If your camera is of the kodak type, set the focus for 3 or 4 ft. with stop F/8, shutter speed 1/25 of a second. This should be about right with most film; however, I am taking it for granted that it is a bright day and sunlight is striking the nest. If the sun does not shine on the nest, it is usually possible to reflect it on by means of a mirror.

When you have your tripod set up, it is a good idea to guard against slipping by tying a rope from leg to leg to act as a substantial tripod brace.

An important thing to remember is not to have the string tight between the shutter release and mousetrap. Have just enough slack in the string so that when the mousetrap is sprung, it will pull only the shutter release and will not jar the entire camera. A few preliminary experiments will show how much slack is required.

Although I have described only one set-up, the same procedure and method can be used when taking close-up photographs of any timid wild animal. One variation is to place some food or something sweet so as to attract the animal into focus.

Artistic Photos Taken *by* CANDLELIGHT

WITH no other light than a candle, many artistic still-life photographs may be taken. The accompanying example was made as follows:

The table was covered with brown paper, held to the wall with thumb tacks and allowed to hang in a natural curve. The brass candlestick was placed in the center of the table; the glass, half filled with ink, in front and to the left. The camera was set up directly in front, 6 ft. from the candle, pointing down at about 25 deg. towards a point 2 in. below the wick. Focusing was done on the nearest part of the candlestick. An exposure of 20 seconds at F/4.5 on panatomic film was given, but 15 seconds would have been more nearly correct. The film was developed in fine-grain developer and fixed and washed in the usual manner.

In this work it is best to use some type of yellow-sensitive film, and an F/8 or faster lens. A good tripod is also essential.—RONALD L. IVES.

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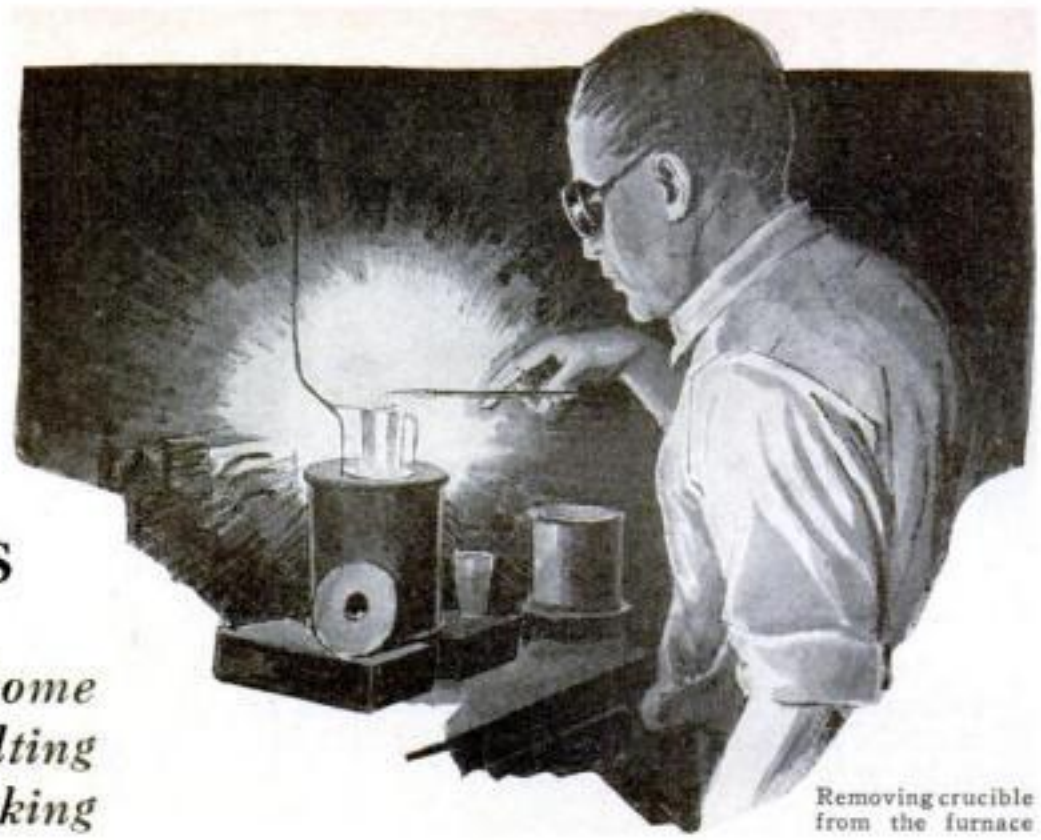


Removing crucible from the furnace

By LEO G. HALL

A SUBSTANTIAL electric furnace for melting metals, heat treating, brazing, glassmaking and many other uses can be made by the home mechanic for less than two dollars. Various types and sizes can be made; but a good general utility furnace, going to about 1,800 deg. F. on 700 watts, will have a heating chamber about 3 in. in diameter by 6 in. deep. It will take a 2½-in. diameter fire-clay crucible and will melt two or three pounds of metal.

Obtain a tin can at least 6 in. in diameter by 8 in. deep. If a paint can is to be used, scrape off or burn out every trace of paint.

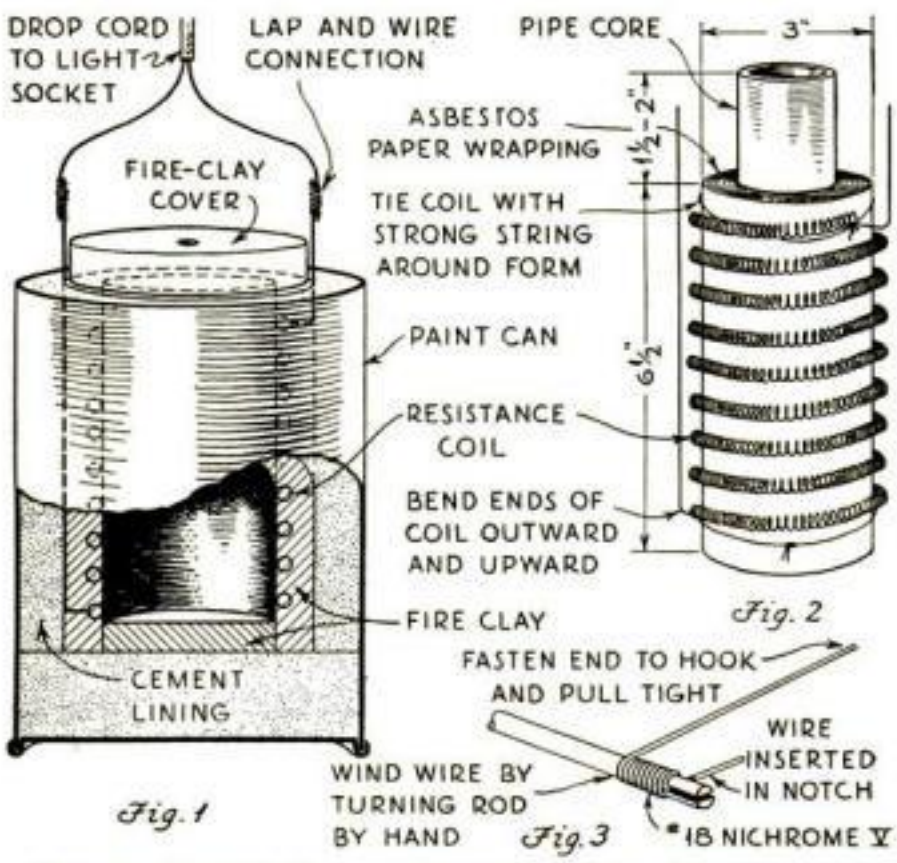
A good material for the outer lining is a mixture of equal parts of Portland cement and asbestos pulp. This latter is a dry white powdery material that can be bought in bulk for a few cents a pound at most large hardware stores and furnace repair shops. About five pounds of each will be needed. If, however, the asbestos pulp is not obtainable locally, an equal quantity of fine sand may be substituted, although sand is not so good. The ingredients should be mixed dry. Knead out all lumps and continue mixing until the powder is uniform in color throughout. Then add water a little at a time and knead until the cement is a moist, crumby mass, but not so wet that water can be squeezed out of it in the hand. Ram a layer 1½ in. deep into the bottom of the can with a heavy stick or iron bar, using considerable force. This layer is a solid support for the form to be used in making the cylindrical part of the lining (Fig. 1).

THE form, 4½ in. in diameter by about 8 in. long, must be made collapsible so that it can be drawn out after the lining has been molded. A piece of pipe or tubing, or an old bottle, 3½ or 4 in. in diameter, tightly wrapped with asbestos paper to build it up to the required size, will serve the purpose. The asbestos paper can be held in place with a few turns of friction tape. Most large hardware stores sell asbestos paper for a few cents a square yard.

The form, which should be made before the cement is moistened, is set upright in the center of the can, on the rammed-in bottom. The cement then is rammed in around the form as compactly as possible. Take care to ram equally on all sides of the form so that it is not crowded away from the center. To obtain uniform compactness and heat insulation, the cement should be put in by layers, 1 in. or less deep. Ram in each layer thoroughly before adding the next. The lining is built flush with the top of the can and may be finished off with a putty knife or trowel. For finishing, have the cement a little more moist. The core is then pulled from the form, and the asbestos paper torn out.

Give this first lining about a day to set before molding the inner lining. It must be kept moist while setting. The setting may be hastened, if desired, by painting the surface with a coat of water glass diluted with an equal volume of water. Undiluted water glass is too thick to penetrate the pores of the cement.

The furnace is now ready for the inner lining, into which the electric resistance is molded. This resistance should consist of 40 ft. of No. 18 nichrome V wire or 36 ft. of ordinary No. 18 nichrome wire. The former is better because it oxidizes much more slowly and has a much longer life. A smaller, shorter wire having the same resistance could be used, but it would not last nearly so long. The wire must be coiled on a ¼-in. round rod about 2 ft. long. If a back-geared lathe is not handy, this coil may be made by mounting a breast drill in a vise, clamping the rod in the drill chuck, and turning the crank with one hand while feeding the wire onto the rod with the other. It also can be made by cutting a notch in the end of the rod with a hack saw (Fig. 3), slipping the end of the wire into it, and turning the rod with the hands while winding the wire upon it. The wire must be kept tightly stretched to make a close coil.



Cut-away view of the furnace and method of winding the resistance coil

ABOUT 8 in. of wire at one end and 2 in. at the other must be left straight. The coil is slipped off the rod and stretched out about 6 ft. Take care that the stretching is everywhere uniform, and that all the turns are equally spaced. The coil must now be wound on the form for the inner lining.

This inner form, like that for the outer lining, may be made of asbestos paper wrapped on a pipe core so as to have a diameter of 3 in. and a length of 8 in. (Fig. 2). The long end of the resistance coil is fastened ½ in. from the bottom of the form by looping a strong string around it and tying the ends around the form, as shown. The coil is then wrapped tightly around the form *(Continued on page 82)*

CROSSED ANCHORS FRAME PICTURE OF SHIP

Plywood, rope, and decorator's clay are combined in making this nautical picture mount

YOUR favorite ship picture or an enlarged photograph of a ship or ship model can be given a nautical setting by mounting it on a plaque like the one shown.

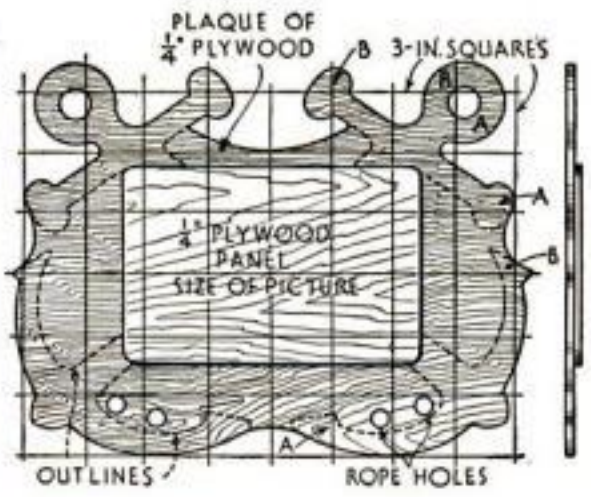
Make a pattern on wrapping paper, trace it on a piece of ¼-in. plywood 19 by 24 in., cut the outline to shape, and make the holes indicated. Cut another piece of plywood the size of the picture and glue it centrally on the face of the plaque. Then give the face and edges of the plaque one coat of white shellac.

From an art store get two 1-lb. cans of molding clay and a small can of stipple clay. Roll large dabs of the molding clay between your hands until soft, and build up the anchors with it. Tacks may be placed in the plywood for reënforcement where the clay is used. In shaping the anchors, points *A* are made higher than points *B*.

A layer of stipple clay from 1/16 to ⅛ in. thick is put on the plywood between the anchors and the board on which the picture is to be placed. Use a small, stiff brush to get the stipple effect. Allow from 24 to 48 hours for drying, then sandpaper the rough places on the anchors.

Next mix some gold bronze with "banana" oil and paint the clay and the edges of the plaque. When this is dry, mix some burnt umber with turpentine and paint as before. Let this set about a half hour; then wipe off the stipple work with a rag. Wait another half hour and wipe the anchors, which should be darker than the stipple.

A pleasing effect may be had on the stipple work by daubing on oil colors that will harmonize with the colors in the picture and blending them together with a rag before completely dry.

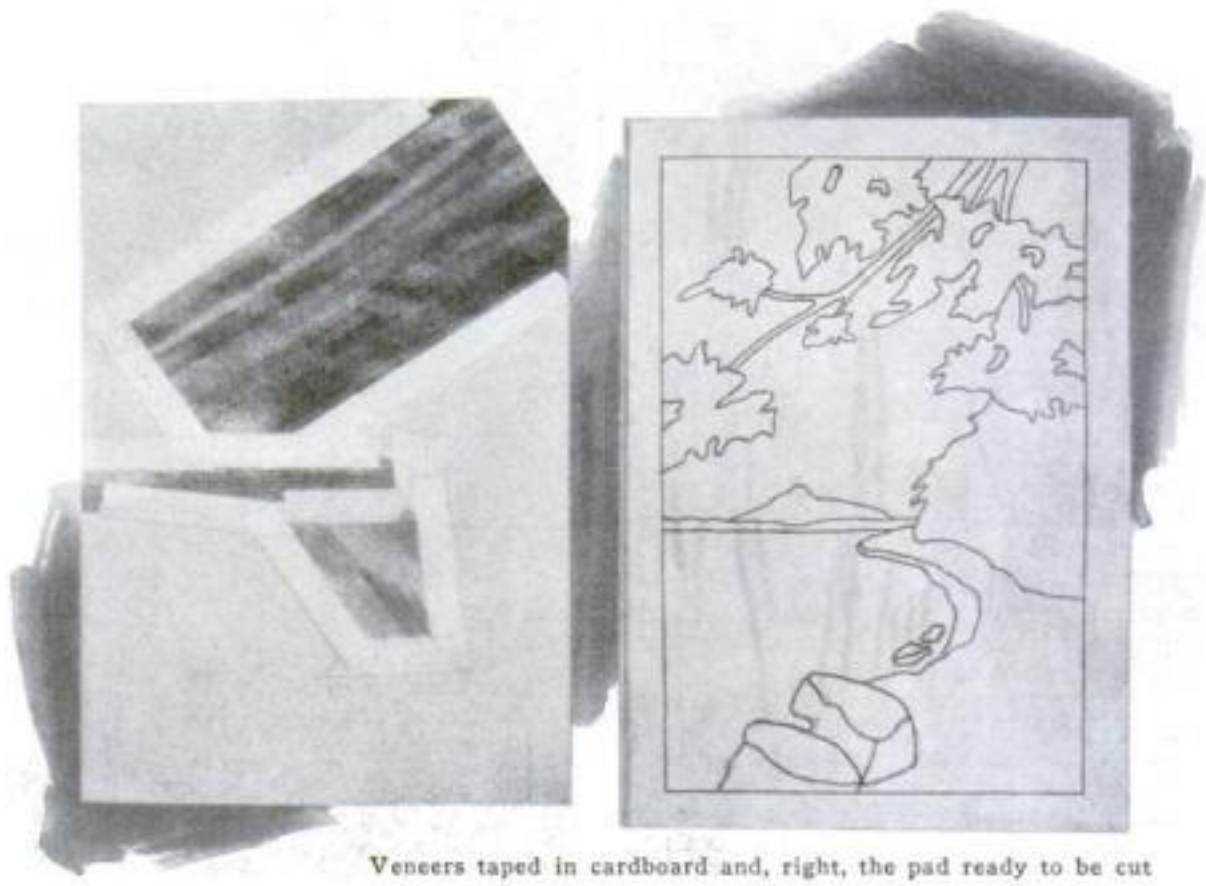


After the plaque has been cut out, a thin panel the size of the picture is glued to it

The picture is now glued in place, and a little floor wax is spread over the face of it with the fingers. Two pieces of ½-in. rope 6 ft. long are nailed on, and tied, as shown, then painted gold bronze.—J. P. KNIPP.

THE ART OF MAKING INLAID PICTURES

(Continued from page 61)



Veneers taped in cardboard and, right, the pad ready to be cut

the work slowly. First saw out the center and the small pieces, taking care that the saw does not pull out and scatter these pieces. It is advisable to use a pointed stick to press down on them just as the saw completes the cut and hold them in place until the saw is stopped. All these pieces are placed in a box lid or shallow box until ready for assembling. The parts along the edges of the drawing are sawed out about ⅛ in. beyond the edge.

When the jig-saw cutting has been completed, clamp a straightedge along the edges of the drawing and saw through the pad with a miter or back saw. Place the parts thus freed in the box lid until all four edges have been sawed. Be sure to cut all four edges square.

Cut a piece of walnut or mahogany 5-ply wood, having one good side, about 1 or 1½ in. larger all around than the drawing, say 9 by 12 in. You are then ready to assemble the picture, and this is done somewhat on the order of a jig-saw puzzle.

Take a piece of fairly stiff wrapping paper and coat one side with rubber cement, such as is used in repairing rubber tires. Assemble and cement the sawed-out parts on this paper, face side of the picture down. Be sure to get the joints as tight as possible. When it is impossible to get a perfectly tight joint, have the open joint next to the darker wood so that it may be filled in later with composition wood crack filler, or a mixture of very fine sawdust and glue to match the dark wood.

When this work is completed, coat the piece of plywood with white casein glue on the inferior side and glue the assembled parts to this, paper side up. Put the assembly in a glue press, or clamp it securely in any convenient way, and leave for twelve hours.

When the work has been removed from the press, take hold of one edge of the paper and pull it off, after which wash off the rubber cement with a coarse cloth and gasoline. Fill in all drill holes and open joints.

The picture may either be framed or made into a plaque, with or without a border according to the craftsman's own ideas.

There are various ways to finish the work. I find that the less sanding is done, the more artistic the result. If you wish a smooth, glossy finish, however, start sanding with No. 2/0 garnet paper and finish with No. 6/0. Sand each wood in the direction of the grain and use care not to overlap, as sanding across the grain anywhere will leave some scratches. Then apply three coats of clear lacquer or white shellac, rubbed with very fine steel wool and finally with rottenstone and oil. A simpler and very satisfactory finish may be obtained merely by applying two or three coats of *bleached* linseed oil and rubbing between coats with a soft rag. Each coat should be allowed to stand ten or fifteen minutes, then be rubbed perfectly dry. Wait at least twelve hours before applying the next coat. The more rubbing, the greater the sheen. Bleached linseed oil does not darken the wood like boiled oil.

In "wooding," that is, in selecting the different veneers, the light-colored woods are the background, and the pieces gradually become darker until the dark woods form the foreground. For instance, the sky is the lightest in color, and water is a shade darker no matter in what part of the picture. There are also occasional pictures in which the general rule is reversed. Only from experience can one acquire the art of wooding. It is advisable for the beginner, after making the picture "Shady Cove," to purchase designs accompanied by the woods. Two or three such designs if carefully followed, will give considerable practice.

When necessary, veneers may be stained before being cut, but I have never required this artificial aid in making up a picture. Small pieces may also be shaded by scorching them slightly in hot sand, but the same effect can be obtained more naturally by choosing wood in which the color varies from light to dark.

NEWS OF GUILD CLUBS

CLUBS have just been chartered in Auburn, Calif., and Collingswood, N. J. Ray O'Reilly is president of the first, and Michael J. Rudolph of the second.

Middletown (Conn.) Homeworkshop Club. At the annual exhibit James Henderson won the Popular Science Craftwork Medal for a maple tilt-top table. Second prize went to W. Kenniston for an inlaid walnut telephone table, and third prize to Mr. Henderson for a mahogany coffee table.

Topeka (Kan.) Homeworkshop Club. The grand sweepstakes prize in the country-wide bird-house contest, of which this club was one of the sponsors, was awarded to Dale Calhoon of the Washburn (Topeka) High School. His entry was a martin house built from Popular Science Monthly plans.

MODEL MAKER'S CABINET FOR UPSTAIRS USE

IN FITTING up a spare bedroom for use as a model-making workshop, I needed a tool rack which would not mar the walls and also some shelving for various small sundries. Two inexpensive all-metal cupboards were therefore purchased, 5 ft. 6 in. high, 14 in. wide, and 12 in. deep, with doors. These may be found in most department and house-furnishings stores.

For the tool rack I cut a piece of three-ply wood 40 in. wide by 30 in. high. On this I screwed three ½ by 1 in. battens, with short pieces of varying widths between the battens and the panel so that the tools could be inserted in the openings as shown. The lowest batten is 6 in. from the shelf, and the other two are each 8½ in. higher.

A self-contained and easily moved tool rack with metal cabinets at each end for supplies

Next, I cut two 1 by 2 in. battens and screwed them vertically to the back of the cupboards on the inside corners, leaving one half projecting. I also cut a shelf the same length as the panel, and for this screwed battens to the sides of the cabinets in such a way that the shelf would slide under the panel and support it from the bottom. Washers should be used under the heads of the screws used for fastening the battens to the cabinets, to prevent their pulling through.

When the battens were in place, I set the cabinets upright, screwed the shelf in position, set the panel on it, screwed that to the battens, and then got someone to help me lift the whole against the wall. Another shelf may be laid or fastened across the top, and another lower down, if you wish, but I use the space at the bottom for my scrap wood box and the like.

For heavy tools that will not go in the rack, I punched holes in the cabinets and inserted large hooks made of stiff wire. There are also a number of cup hooks screwed into the battens.—P. O'N.

ATTACHING INITIALS TO CELLULOID RINGS

WHILE making a celluloid ring as described in a previous issue (P.S.M., Mar. '35, p. 63) I hit upon a novel way of attaching initials. If you put a drop of acetone on the front piece of the ring and press the thin celluloid in place, it leaves marks which are next to impossible to remove, because you cannot polish the ring around the small initials. My plan is as follows:

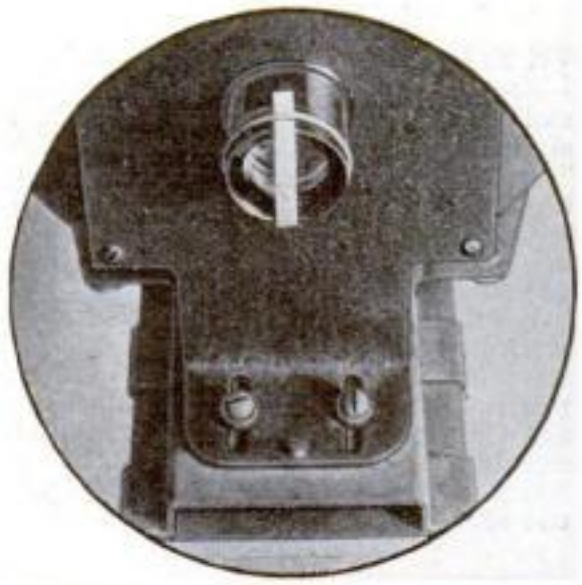
Cut the desired initials in thin celluloid of a contrasting color to the front piece. Fasten the initials on the front piece (which should be perfectly level) with ordinary glue. Scrape the glue from the edges of the initial with a pointed knife. Then half fill a metal jar lid with acetone and, holding the back of the ring between two fingers, dip the front in the acetone till the initials are covered. Hold the ring for half a minute; then lay it down to dry thoroughly. This welds the initials on the ring.—E. F. TROUP.

STRIP HELPS TO FOCUS ENLARGEMENTS

WHEN using photographic enlargers which do not have the automatic focusing feature, it is often rather difficult to get the image on the enlarging easel exactly in focus. Much time is lost in focusing, and the eyestrain is considerable. A device to aid in this part of the work can be made quickly.

Cut a strip of paper, preferably black, about 2 in. long, the width being one fourth the diameter of the enlarger lens. Put this strip across the front of the lens as shown, and secure it with a rubber band. When the image is out of focus, two nearly superimposed pictures will be seen on the easel; but as the point of correct focus is approached, the two pictures will blend into one. Of course, the paper strip is removed before making the enlargement, although leaving it on will do no harm except to lengthen the exposure required.

If you prefer to make the device of metal, cut a piece from a discarded film-pack holder and bend the ends so that they will press lightly against the lens barrel.—W. C. VESTAL.



Focusing strip applied to an enlarger lens. White was used in this case so it could be seen, but black paper or metal is preferable

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SHIP AND COACH MODELS

{Construction kits are available for some of these models. See page 80.}

Aircraft Carrier—U.S.S. *Saratoga* (18-in.) and flush deck destroyer (6¼-in.), *226-227-R*	.75
Battleship—U. S. S. *Texas* (3-ft. hull), *197-198-199-200*	1.00
Bottle, Clipper Ship in, *121-122*	.50
Civil War Ships *Monitor*, *Merrimac*, and *Hartford* (3½, 5⅜, and 5⅛ in. long respectively), *258*	.25
Clipper Ship (20½-in. hull), *51-52-53-R*	1.00
Clipper, Simplified (9½-in. hull), *219*	.25
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Destroyer—U. S. S. *Preston* (31½-in. hull), *125-126-127-R*	1.00
Galleon *Revenge* (25-in.), *206-207-208-209*	1.00
Hartford, Farragut's Flagship (33½-in. hull), special prints *221-222-R*	1.50
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Liner—*California* (12½-in.), *251*	.25
Liner—*Normandie* (20⅝-in.), *264-265*	.50
Liner—*Manhattan* (12-in. long), *204*	.25
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Privateer of 1812—*Swallow*, a Baltimore clipper (13-in. hull), *228-229-230-R*	1.00
Santa Maria (18-in. hull), *74-75-76-R*	1.00
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Steamships *Savannah* (3 in. over all) and *Atlantic* (6-in.), *235*	.25
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NOTE: Full-size patterns for any boat marked with an asterisk (*) will be drawn to order for $1.50 extra. Simply add this amount to the cost of the blueprints. About one week is required to fill orders for patterns.

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Toy Drill Press, Lathe, Saw, etc., *113*	.25
Toy Dump Truck, Fire Engine, etc., *101*	.25

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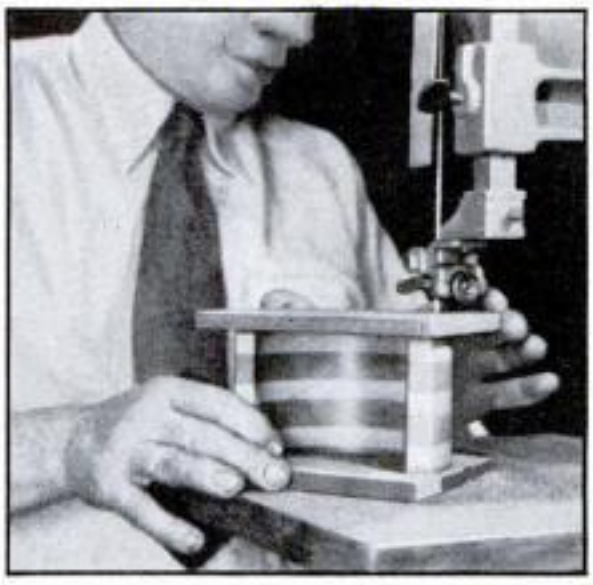
TWO CIGARETTE BOXES

(Continued from page 63)



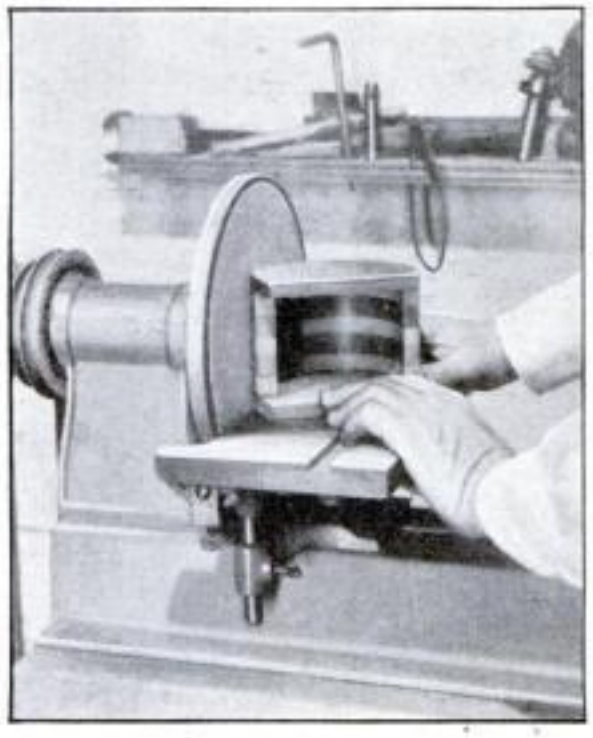
Trimming the sides after they are glued on

section, having flats in their circumference.

Most of the finishing may be done on drum and disk sanders, using a fine grade of paper—about No. 1 for forming and No. 00 for finishing. After sanding the inside of *D* and *B*, glue the sides *J* to *B* and two pieces of ¼ in. thick dark wood to *D*. These last mentioned pieces of wood, each 2¼ in. wide by 3 in. long, are the only extra material required.

The sides of both boxes should be left "in the square" and trimmed to size after being glued in place. Form and polish the feet and handles *E*, *F*, *G*, and *H* on the sander. Fit lids, and brad and glue on the feet and handles.

To obtain the utmost contrast, finish with white shellac or with clear lacquer. A smoother finish, however, may be obtained by putting on a very thin coat of transparent filler. Cover the filler with several coats of shellac or with rubbing varnish.—Donald A. Price.



The outside may be finished on a disk sander

ELECTRIC ROASTER

(Continued from page 62)

ing the wood. Bore holes through the uprights and run the wires from the electrical panels through these holes, and thence through holes in the base.

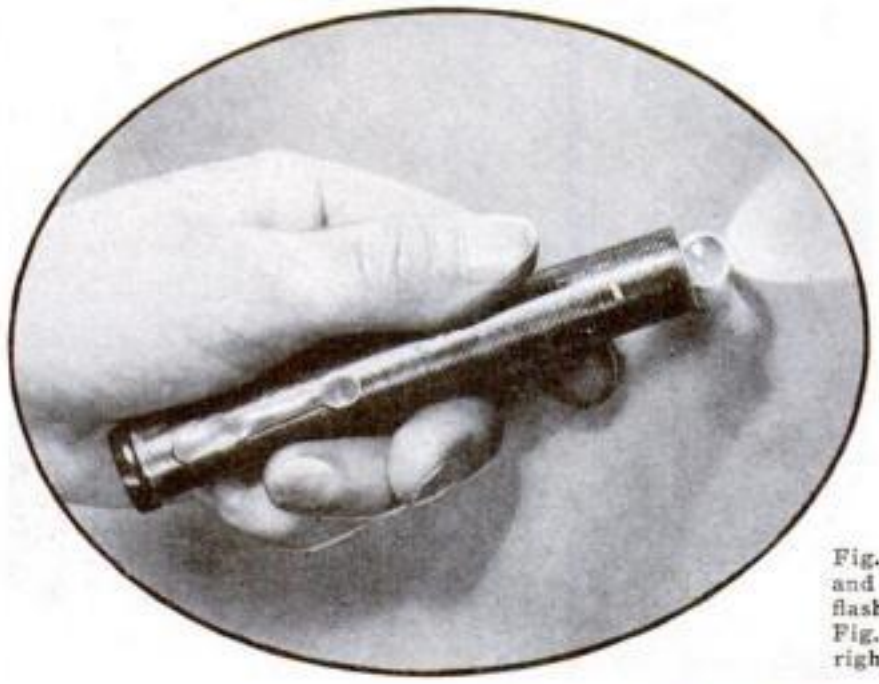
Place the shaped toppieces over the panels. Mount the base on rubber-headed tacks, and put a switch either on the base or in the electrical cord itself. A tin drip pan, made to fit between the uprights, will protect the base.

To use, turn the current off, place one or more "hot dogs" on the terminals, and turn on the current.—W. T. Baxter.

FUTURISTIC

Flash Light

MADE OF CELLULOID AND WIRE



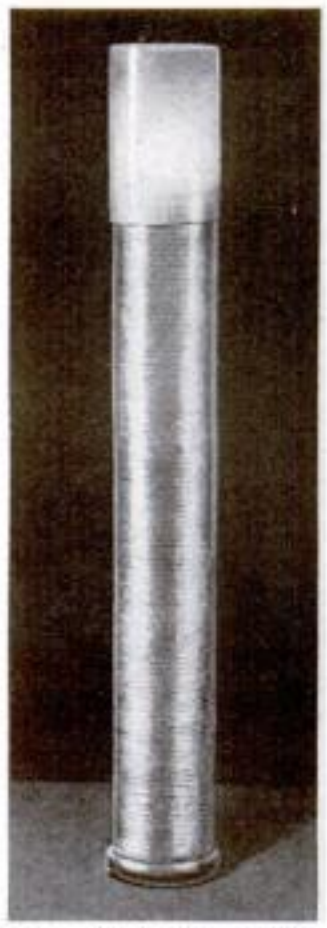


Fig. 1 *(at left).* Unbreakable and of striking appearance, this flash light is easy to construct. Fig. 2 *(above).* Used as an upright lamp for temporary lighting

CELLULOID from an old auto side curtain or any other clear celluloid can be used for making the modern-looking, vest-pocket size flash light shown in Fig. 1. It has a striking appearance, resembling a miniature Telsa coil, and could be mistaken for a futuristic "heat-ray" projector. The case is unbreakable and will stand a lot of banging around. It uses an unbreakable 2.5-volt lamp with solid glass bulb, casting a prefocused spot beam (although an ordinary bulb would do).

First get a 6-in. piece of 5/8-in. hardwood dowel. Wind this closely with either No. 20 copper wire or No. 22 brass wire, the ends being held in holes in the ends of the dowel. Around the wire wrap tightly a sheet of clear celluloid—enough for three thicknesses. The celluloid is "welded" into a solid case around the wire with a solvent consisting of one part amyl acetate ("banana oil") and two parts acetone. Paint this mixture on the first three inches of celluloid to be wrapped (Fig. 3) until it is quite flexible and can be wound on without air bubbles. The softened surface will fill the depressions between the turns of wire. For wrapping the remainder, use plain acetone, rolling up the celluloid immediately it is applied. After ten minutes, carefully knock out the hardwood dowel core, and allow the case to dry over night.

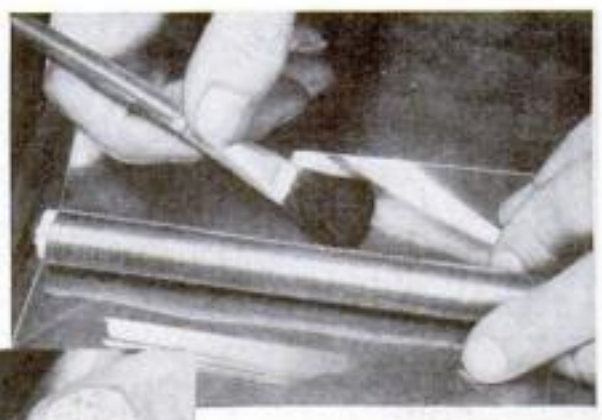


Fig. 3 *(above).* Painting a mixture of acetone and amyl acetate on the celluloid that is to be wound around the wire coil. Fig. 4 *(at left).* Winding wire around the plug used at bottom of flash light

Fig. 5. Cementing together two flat pieces to make a disk for the plug shown in Fig. 4

With a file, smooth the outside, particularly the line left by the ridge. Finish with fine sandpaper, and restore the gloss by painting with acetone. Trim the ends to give a length of about 5 in.

To make a cap for the bottom, wrap and cement a narrow strip of celluloid around a short, flathead screw. When this plug has been built up to form a rather loose fit inside the case, wrap it tightly with copper wire as shown in Fig. 4. Apply acetone so that the wire will sink into the surface; also see that the wire makes good contact with the screw. Cut two pieces of red celluloid toothbrush handle, file them flat, and cement the edges together (Fig. 5). Round the piece with a file and cement it with acetone to the wire covered plug, which fits into the bottom of the case as shown in Fig. 6. The turns of wire on the plug, and in the case, serve as threads. When the flash light is completed, a turn of

Fig. 6. The plug, with disk attached, fits like a screw into the end of the flash light

the cap makes contact and flashes on the light.

Around the threads of the bulb, wrap more turns of wire; then wrap with a narrow strip of celluloid, using acetone for cement, until it forms a socket fitting tightly in the top of the case. Figure 7 shows the socket partly made. Bend the end of the wire into a loop so that, when it is inserted in the case, it will make contact with the turns of wire in the latter. Cement the socket in place with celluloid scraps dissolved in acetone.

Attach a heavy pencil clip. To do this, cut away that part of the clip which ordinarily passes around a pencil, leaving only two prongs. These may then be pressed into the case and cemented.

Figure 2 shows a novel way of using the flash light as an upright lamp for temporary lighting. Wrap a 1½ by 5 in. strip of celluloid into a tube that fits the top of the case tightly. In one end of the tube cement two celluloid disks. "Frost" the inside of this shade by rubbing the celluloid with sandpaper until it has the white appearance of ground glass.—E. A. Bower.

Suggestions from readers are invited in regard to making craftwork projects from celluloid and other modern plastics, either in the form of thin sheets or rods and tubes.

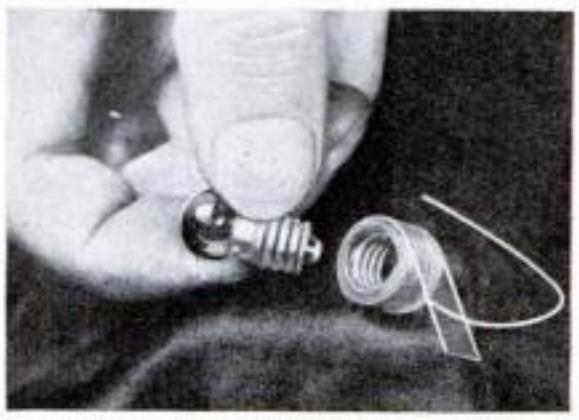


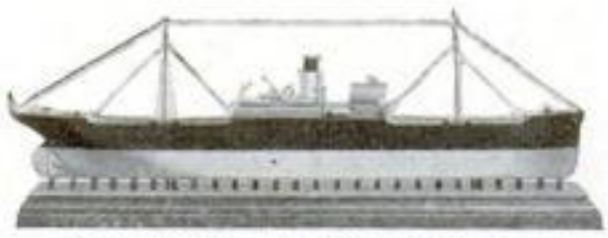
Fig. 7. Partly finished socket with wire on the inside that makes contact with the case

CELLULOID SIMPLIFIES SHIP MODEL MAKING

In constructing numerous ship models, I have found it difficult to paint the cabin doors and windows neatly on wood. It was always a time-consuming job, and the results were never quite satisfactory. Now I make the doors and windows on an overlay of sheet celluloid—not clear, but preferably of a cream or ivory color. An advertising calendar and an old celluloid card tray have provided material for several models. The surface is prepared by rubbing it with fine sandpaper. Lines may then be drawn on it with ink, or paint may be used if preferred. When this has been done, apply a protective coat of clear varnish and cement the celluloid in place. Cream or ivory colored celluloid also is excellent for ship-model name plates and for inlays for various purposes.—E. A. Darmer.

NEW KIT CONTAINS MATERIALS FOR

A Freighter Model



KIT 2M—Ocean freighter, 14 in. long

THIS month we add another low-priced construction kit to our series. It contains complete materials for making a 14-in. model of an ocean freighter of the famous war-built design known as "Hog Islanders." The price is only $1.50, postpaid anywhere in the United States or Canada.

The model is of the full-hull type. Selected sugar pine is provided in the kit for the hull blocks and other wooden parts, and there is an ample supply of all other necessary raw materials, including three bottles of paint. A blueprint with full-size drawings accompanies the materials.

The kit has been especially prepared for the Popular Science Model-of-the-Month Club, but is available to other readers on the same terms so long as the supply lasts. Some of the Model-of-the-Month kits are already exhausted, so do not delay in ordering. Ask for kit 2M.

The complete list of our kits is as follows:

STANDARD SHIP MODEL KITS

A. Whaling Ship *Wanderer*, 20½-in.....$6.90*
AA. With hull lifts sawed 7.40*
D. Spanish galleon, 24-in. 6.45*
DD. Same with hull blocks shaped..... 6.95*
E. Battleship U.S.S. *Texas*, 3-ft..... 6.95*
EE. Same with hull lifts sawed 7.45*
G. Elizabethan galleon *Revenge*, 25-in..... 6.75*
GG. Same with hull blocks shaped 7.25*
L. Farragut's flagship *Hartford*, a steam-and-sail sloop-of-war, 33½-in. hull 7.95*
LL. Same with hull lifts sawed 8.45*
Q. Privateer *Swallow*, 12½-in. hull, with lifts sawed to shape..... 4.95†
V. Clipper *Sovereign of the Seas*, 20½-in. hull, with lifts sawed to shape..... 4.95†
Y. Trading schooner, 17½-in. hull..... 4.90†
2S. U. S. Destroyer *Preston*, 31½-in. hull, with lifts sawed..... 5.95*
3S. *Constitution* ("Old Ironsides"), 21-in. hull, with lifts sawed..... 6.50*

SIMPLIFIED SHIP MODEL KITS

F. Liner S.S. *Manhattan*, 12-in..... 1.00
H. Cruiser U.S.S. *Indianapolis*, 12-in. 1.50
J. Clipper ship *Sea Witch*, 13-in..... 1.50

MODEL-OF-THE-MONTH KITS

M. Aircraft carrier *Saratoga*, 18-in..... 1.00
N. Four U.S. destroyers, each 6¼-in. .75
O. Liner S.S. *St. Louis*, 11-in..... 1.00
R. U. S. cruiser *Tuscaloosa*, 11¾-in... 1.00
T. U.S.S. *Brooklyn*, armored cruiser in Spanish American War, 8-in..... .75
U. *Hispaniola*, the ship in "Treasure Island," 7-in..... .50
Z. H.M.S. *Bounty*, 11½-in..... 1.50
1M. Show boat, illuminated, 14-in..... 1.50
2M. Ocean freighter, 14-in..... 1.50

MISCELLANEOUS

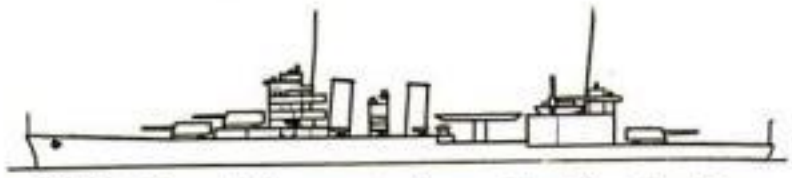
No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble and stain included 5.75*

No. 5. Solid rock maple hanging wall rack with one drawer, 19½ in. wide, 33¼ in. high. Ready to assemble and stain included..... 5.75*

No. 6. Solid rock maple butterfly table, top 19 to 22 in., height 22½ in. Ready to assemble and stain included..... 6.90*

No. 7. Whittling kit with two shaped blocks for making sea captain 5½ in. high..... 1.50

NOTE: If you live west of the Mississippi River or in Canada, add 50 cents to all prices marked with an asterisk (*) and 25 cents to all prices marked with a dagger (†). Otherwise all prices are postpaid anywhere in the United States or Canada. The kits marked with an asterisk or dagger will be sent C.O.D. in the United States upon request, but the purchaser will have to pay 28 cents additional.



KIT R—Materials for a water-line model of the *Tuscaloosa*

KIT A

KIT J—*Sea Witch*

KIT U—*Hispaniola* of "Treasure Island"

Popular Science Monthly,
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Please send me Kit.....for which I inclose $.....(or send C. O. D. ☐)

Name .....

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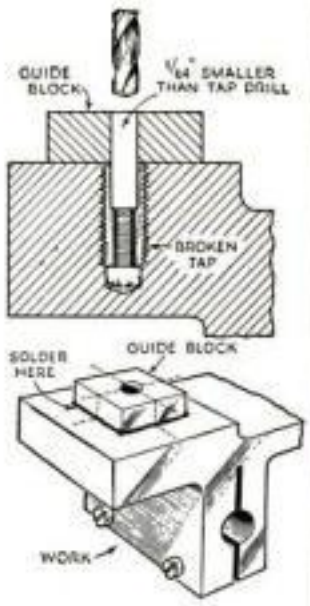
(Print name very clearly.)

Remit by money order, check, or registered mail. No kits selling for less than $4.00 can be sent C. O. D. This offer is made only in the United States and Canada.

REMOVING A BROKEN TAP FROM FINISHED WORK

WHEN a small tap breaks off in a model or instrument, it generally remains immovable even after a lot of patient labor. Some workers advise the use of a mixture of sulphuric and nitric acid for loosening the piece of broken tap, but this enlarges the threads, and even then the piece of broken tap is hard to fish out.

Some time ago I inadvertently broke a 6-32 tap in a finished brass casting. First, I heated the casting to anneal the broken tap. While it was cooling, I scribed two lines across the center of a ¼ by ⅝ by ⅝ in. block of cold-rolled steel, extended the lines down the sides of the block, and put a center-punch mark at the intersection of the cross lines. Two lines at right angles were also scribed exactly across the center of the tapped hole. The block was then clamped temporarily over the hole and the two sets of scribed lines lined up accurately.



A guide block is used in drilling out the tap

The block was next sweated in place with solder and the clamp removed. A drill one size smaller than the tap drill for the threaded hole was used to drill through the block and right into the center of the broken tap.

When the piece of broken tap is reached with the drill, it is necessary to go slowly until past the jagged broken end, and plenty of oil must be used. When the tap has been drilled out, the piece is heated to loosen the block, and the hole is retapped with a new tap to clean out the threads.

This is a sure and safe way to remove a broken tap from a piece of work that has already gone through a series of tedious or comparatively expensive machining operations.—CHARLES H. KRUCHTEN.

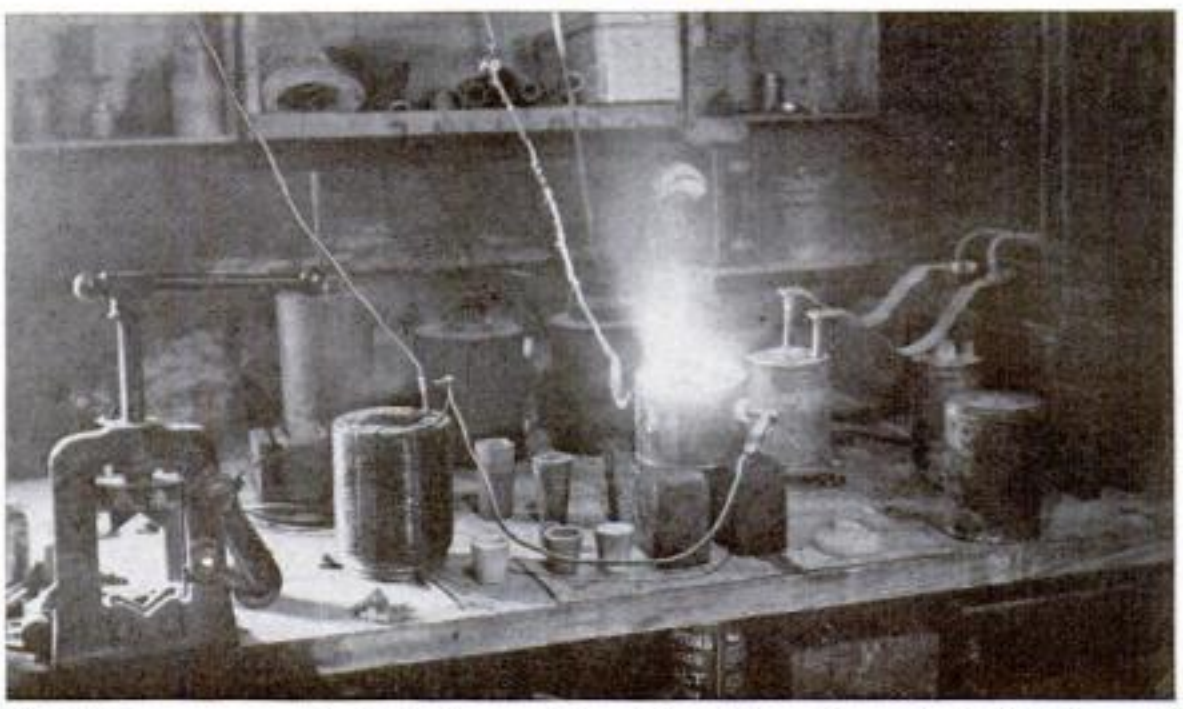
BETTER HE.' DLIGHTS FOR MODEL LOCOMOTIVES

WHEN operating a model railroad at night, the broad, spreading beams from an open-bulb headlight often detract materially from the realism of the model. A miniature headlight that throws a realistic parallel light beam may easily be constructed with a small view-finder lens taken from an old box camera or any similar lens.

The headlight socket on the locomotive is replaced by a metal tube of the same length, but of just the right diameter for the lens to slip through. If the inside of the tube is roughened with a coarse file, the lens may be satisfactorily fastened to the end with colorless cellulose cement. A ¼-in. hole is drilled in the end of the locomotive, and the tube is soldered over the hole. The socket for the bulb is transferred to the inside of the locomotive and is soldered in position so that the bulb filament will be a distance equal to the focal length away from the lens. These small lenses usually have a focal length of about ¾ in., but this may be checked by focusing the sun on a piece of paper and measuring the distance from lens to paper. With the bulb in this position, the headlight will throw a parallel beam that will restore realism to your railroad.—HARRY B. FUGE.

MAKING A SMALL ELECTRIC FURNACE

(Continued from page 72)



Electric furnace corner of author's home workshop. The nichrome furnace is in the background

in a spiral of about seven turns, 5/8 in. apart, center to center. The upper end of the coil is fastened in the same way. The straight ends are bent outward and upward as shown, and the form with the coil on it is set into the furnace on the cement bottom and in the exact center.

If the work has been done properly, the wire ends will project about 2 in. above the top of the can. They should be in contact with the outer lining, or as far from the inner form as possible. The form is now ready for molding the inner lining.

Several more or less costly high-temperature molding cements are on the market, but a good substitute may be made by pulverizing an old fire brick with a hammer on a cement floor and screening about 2 lb. of it through a piece of window screening, then mixing the screenings with 1 lb. of dry powdered fire clay. Some back-yard clays are suitable, but many of them will melt in contact with the wires, which are much hotter than the heating chamber itself. It is safer, therefore, to buy fire clay from a brickyard or a local furnaceman.

The mixed fire clay and brick screenings are moistened slowly and kneaded until the mixture sticks together if squeezed in the hand, but is not so wet as to emit water. If too wet, it will crack when baked. Thin layers of it are then rammed in about the form, but care must be used to keep the rammer away from the wire coils so that they are not displaced. The vertical wire must not be disturbed, and, of course, must not touch any of the turns of the coil. If any of the turns of the coil are accidentally moved into contact with each other, the form and clay must be removed and the molding begun again with the coils in their right place.

When the lining has been molded flush with the top, it may be smoothed with a trowel. The form is then removed, and a ½-in. layer of fire clay is rammed into the bottom of the furnace. Any holes or roughnesses left in the surface around the wires should be filled with fire clay, mixed rather wet and pressed in with a putty knife.

The furnace must be dried for several days in a warm room before heat is applied, or steam may form and cause an explosion. After drying, it is well to paint the top, but not the inside, with a coat or two of the diluted water glass to harden it.

A cover 4½ in. in diameter and ¾ in. thick can be molded of the fire-clay mixture in a tin-can cover or any convenient mold. It should be rammed hard. A ½-in. round hole may be punched through its center before it is dry, so that it can be easily lifted off the furnace with a bent wire. After drying thoroughly, it should be painted with two or three coats of the diluted water glass.

The furnace is now ready to be baked. The two ends of a socket cord are connected to the two ends of the coil wire. Lap the wires and wind the joints tightly with a fine copper wire. Solder, of course, is useless because of the heat. The plug is screwed into a light socket, the cover placed on the furnace, and it is left to bake for from three to six hours. Clay does not give up all its moisture until it is well above red heat. Some steam will be emitted, and the furnace will heat slowly the first time. After two or three heats, it may be expected to reach 1,800 deg. in about an hour and a half.

No melted metal of any kind or chemical salts should be allowed to touch the resistance coil. The furnace should be set on a couple of bricks or on a cement floor.

The temperature can be judged by putting small amounts of various materials into iron pipe caps and setting them in the heating chamber. When aluminum melts, the temperature is about 1,210 deg., F. At 1,360 deg., borax melts; at 1,480 deg., table salt. When pure silver melts, the furnace is at about 1,800 deg. A silver coin melts at a slightly lower point. Use the last-mentioned test when heating the furnace the first time, and turn off the current when the coin melts. If the lining is very well made, the furnace may go to a higher temperature, but should not be allowed to do so, for the resistance coil is likely to burn out. If a long heat is wanted at a lower temperature, the cover may be left partly or wholly off.

Because the current used is less than 7 amperes, an ordinary 15-ampere fuse plug is sufficient.

A furnace built as described has been in daily use for more than two years. With a pair of tongs and some fire-clay crucibles that can be bought at a scientific supply store, it is valuable for many purposes. It has been used for melting type metal, white metal, zinc, aluminum, silver solder, brazing metal, yellow brass, bell metal, speculum metal, and other alloys; as well as for brazing, tempering small tools, working and annealing glass, and baking enamel glazes, homemade crucibles, and pottery. Even synthetic rubies, sapphires, and emeralds have been made in this furnace.

Old Bill SAYS:

WHEN it is necessary to use a dial indicator on a magnetic chuck, fit short brass legs to the base and use a brass tip for a contact point.

• • •

Liquid solder, now available in small tubes, is useful to have in your tool box.

• • •

A periodical flushing with gasoline and the use of high-grade spindle oil will lengthen the life of a high-speed spindle.

• • •

If the proper tap size of hole is drilled and sufficient lubricant is used, a better result can be had by operating a tapping attachment at high speed than at low speed.

• • •

Many a good die is ruined by using it over too large a hole in the bolster plate.

• • •

Wire drills of a cheap grade, if it is necessary to use them, can be made to stand up better by heating the points to a bright red color and dipping them in sulphur before quenching.

• • •

If the jaws of a pipe wrench are chromium plated, they will last at least three times longer.

STREAMLINE MODEL

(Continued from page 64)

Setting one of the engine nacelles in place

to painting the assembled model, mark the location of windows, ailerons, and other details with a hard pencil. The indentations will show through the paint. An attractive color scheme is obtained by painting the body, nacelles, and vertical tails light green; the wings and horizontal tail yellow; and the windows and tires black.

The tail units are held securely with pins

WEATHER VANE TELLS VELOCITY OF WIND

The calibrated radial lines painted on the vane, which represent the degrees of wind pressure or velocity, may be accurately determined by the simple expedient of holding the body portion of the vane out from a moving automobile. The speed as shown on the speedometer produces a corresponding wind pressure on the moving car and, of course, also on the gravity-controlled, swinging disk of the exposed vane. The degree of swing of the disk may be marked on the vane while the car is moving at predetermined speeds.

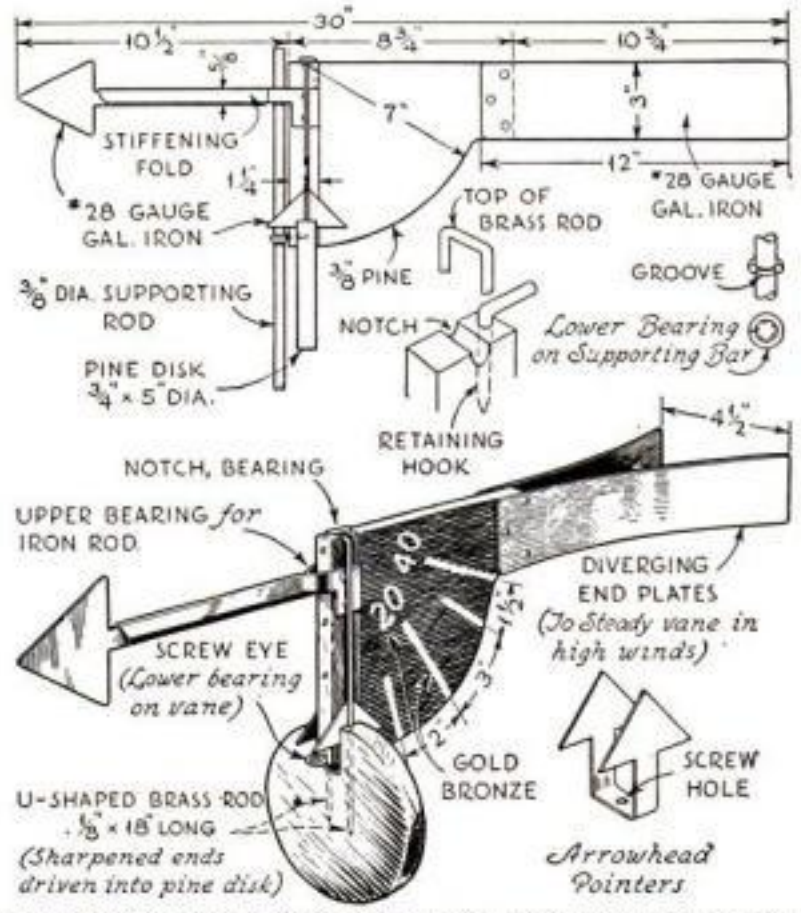
Any desired type of cross arms with the letters N, S, E, and W may be added, but they should be placed in this case above the vane instead of in the usual position.

In observing the vane during a brisk wind, the extreme degree of swing of the disk gives the approximate velocity, especially when there are sudden puffs.—J. D. GARFIELD.

WHILE it is practically as easy to make as any ordinary weather vane, the one illustrated tells not only the direction of the wind, but also its approximate velocity. The vane itself turns with the wind in the usual way, and the swinging wooden disk is blown back to a greater or less degree.

Everyone wants to know from time to time "which way the wind is," as the saying goes. It is the basis for his private local forecast and a good indication as to whether it is going to rain or shine, irrespective of the general weather bureau prediction. Ordinarily there is no weather vane in sight, so it pays to put one up.

Although specific dimensions or the type of materials are not important, the accompanying drawings illustrate the author's construction and are self-explanatory. The finished vane, mounted on the roof of a garage, is shown in the photograph. In this case the body of the vane was made of ⅜ in. thick pine, with a galvanized iron arrowhead and two galvanized-iron end plates, 3 by 12 in. The latter are spread 4½ in. apart at the end by means of a wooden strip nailed between them.



How the vane and swinging disk are made, assembled, and mounted

EASILY ASSEMBLED AQUARIUM AERATOR

AN AQUARIUM aerator of a simple and inexpensive type can be made as shown in the accompanying diagram. The materials required are two 1-qt. bottles; 12 ft. of ¼-in. rubber tubing, marked *3*; 4 ft. of ¼-in. glass tubing, marked *4*; two rubber stoppers with two holes in each, to fit the bottles; and either a commercial regulator and release, which cost very little, or a short length of ¼-in. round reed, the natural ducts through which will serve as an air release. If the latter is used, it will also be necessary to use a valve to control the volume of air.

Insert the stoppers in the bottles, and cut and bend the glass tubing as shown. Use part of the rubber tubing to connect the two longer glass tubes in bottles *1* and *2*, and use the remainder to connect one of the shorter glass tubes with air release *5*. Fill bottle *1* with water to within ½ in. of the short glass tube, and put the bottle on top of the aquarium. Set bottle *2* on the floor, and put the air release in the tank. Blow into the end of the short tube in bottle *1* to start a flow of water from bottle *1* to bottle *2*. Adjust the air release to get a very fine stream of bubbles. The finer the stream, the longer the aerator will operate without attention.

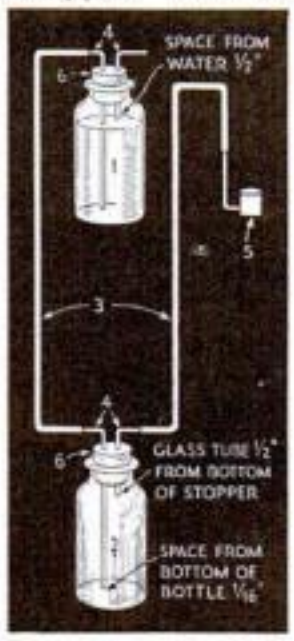
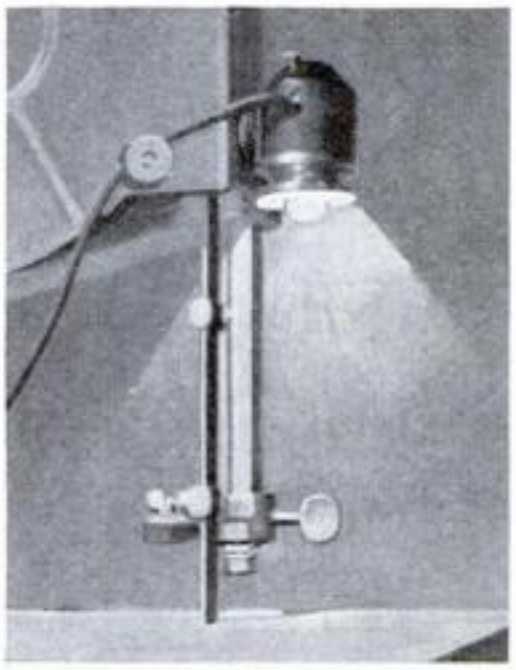


Diagram showing way to set up the bottles

As the water gradually flows into bottle *2*, air is forced into the tank. When the lower bottle is filled, the position of the bottles must be reversed, and the tubing leading to the air release transferred from one to the other. To change the connections takes only a moment and soon can be done almost automatically.

The connections and stopper, of course, should be air-tight. If the release is properly adjusted, air will be supplied for hours without attention. The advantages of this aerator are that it costs little, requires no current to operate, and can be used where there is no convenient outlet for a motor-driven aerator.—ARTHUR E. LANDMAN.

SUCTION-CUP SHOP LAMP MADE FROM ASH TRAY



A ten-cent auto ash tray forms the body and reflector of this movable shop light

THIS general utility suction-cup lamp has proved particularly useful around my home workshop. It is made from a ten-cent auto ash tray and has a rubber suction cup attached on the side so that it can be mounted on almost all my tools, even on the underside of the band-saw table when I am adjusting the saw blade.

Inside is a miniature socket for the small style of 110-volt electric bulb. It is necessary only to pry the rim off the ash tray, drill two holes through the opposite end for the socket bolts and a hole through the side for the cord, and reassemble.

The chromium top of the ash tray reflects the light sufficiently. Of course, there is the customary 6-ft. length of lamp cord and plug attached.

There is enough radiation of heat so that the bulb will not burn out. I also lined the inside of the ash tray with tin, although the light is ample for most purposes without going to that trouble.—WALTER K. MOSS.

PLATING INNER SURFACE OF BRASS BOWLS

THERE is so much popular interest in hammered and spun copper or brass bowls that it is of value to know how the inside surfaces of such bowls may be easily plated with a low fusion metal such as tin or pewter. This type of plating gives a pleasing contrast in color, and at the same time renders the bowls more suitable for bonbon containers. It cannot, however, be used to plate an article that contains soft soldered joints.

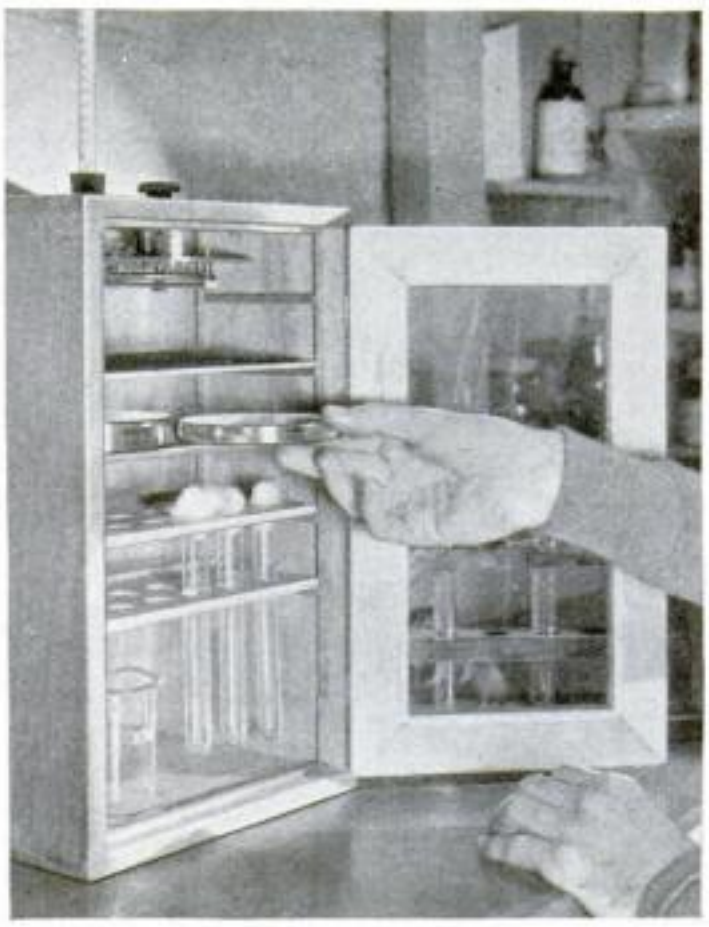
Remove all tarnish from the surface to be plated by scouring it with steel wool. After the surface is thoroughly cleaned, slightly heat the bowl and smear the inside with paste soldering flux. Then place a few scraps of pure tin or high-grade pewter in the bowl, and continue the heating. As soon as the plating metal melts in the bottom of the container, use a pair of tongs to move the container around in such a manner that the plate will be distributed over the surface. A wooden stick will be useful in pushing the molten metal out to the edge of the bowl. Care should be exercised to avoid tinning the outside of the bowl.

After the surface is completely covered, throw out the excess metal, and wipe the plated surface while still hot with a clean cloth. This procedure will remove all dirt and any excess material that has remained in the bowl, and at the same time give the surface a polished appearance.—GEORGE A. SMITH.

INEXPENSIVE

Incubator Cabinet

for Microscope Cultures



Petri dishes are kept on movable shelves above test tubes

ONE of the most useful pieces of equipment that the amateur can construct for his microscope laboratory is a small electric incubator in which a constant temperature can be maintained. Then bacteria cultures may be kept at the proper temperature for rapid growth, insect eggs may be hatched, and hay infusions and similar cultures of microscopic creatures may be kept in a flourishing condition. By readjusting the thermostat, the incubator can also be used as an oven for keeping paraffin wax in a molten state while it penetrates specimens being imbedded.

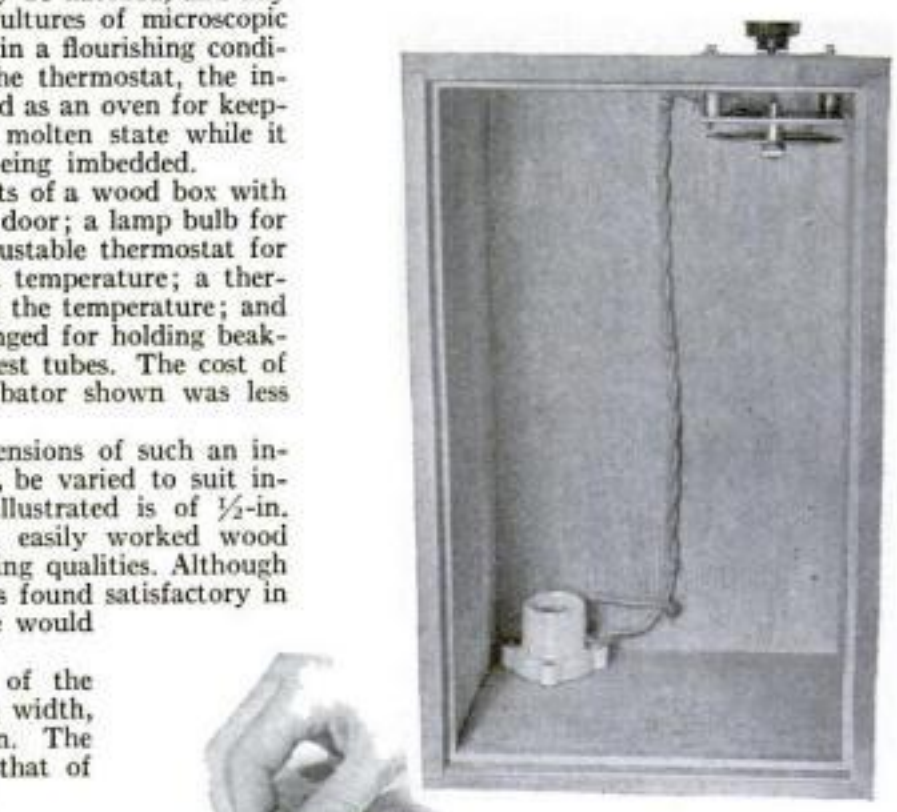
The incubator consists of a wood box with a glass-paneled, hinged door; a lamp bulb for supplying heat; an adjustable thermostat for maintaining a constant temperature; a thermometer for indicating the temperature; and a series of shelves arranged for holding beakers, Petri dishes, and test tubes. The cost of materials for the incubator shown was less than three dollars.

The design and dimensions of such an incubator can, of course, be varied to suit individual needs. That illustrated is of ½-in. redwood, which is an easily worked wood with good heat-insulating qualities. Although a single glass panel was found satisfactory in the door, a double one would reduce the heat loss.

Outside dimensions of the box are: Height, 15 in.; width, 9½ in.; depth, 7½ in. The height is the same as that of the ordinary standard microscope cabinet which was to share the laboratory table with it. The door is made of ½ by 1½ in. strips, rabbeted along the inside edges to receive the glass, which is held in place with wood strips. Use casein glue, which is odorless, in all joints. Three small brass hinges and a small brass knob are required. The catch consists of a roundheaded brass nail in the edge of the door; when the door is shut, this presses against a strip of thin metal bent so as to form a springy socket.

The thermostat is built around a 3-in. ether-wafer unit originally intended for a poultry incubator, purchased for 35 cents. A larger, double wafer is available for 55 cents, but is too bulky for an incubator of this size. The small wafer has a threaded pin projecting from the center of one surface, and a hollow-end stud from the center of the opposite surface. When the wafer is warmed, the ether vapor inside it expands, forcing the sides apart like the bellows of an accordion. Cooling causes the disk to contract. The amount of expansion or contraction is proportional to the temperature.

The disk is supported on a 3 by 4 in. piece of bakelite composition or other insulating material (even wood, if of a kind that will not warp noticeably). If you use a hard composition, you can drill holes and thread them to receive 6-32 machine screws so that the use of nuts may be avoided. Mount the disk on a strip of metal about 1 in. longer than its diameter by inserting the threaded stud through a hole and clamping it with a nut, and screw the strip to the square base as shown. Place washers or short *(Continued on page 87)*



Where thermostat and socket are placed inside cabinet. *Left:* Attaching the contact strips, which had been removed from a discarded telephone jack

INCUBATOR CABINET

(Continued from page 86)

metal tubes under the ends of the strip so that the hollow stud of the thermostat wafer is about ⅛ in. from the surface of the base piece. Drill a ¼-in. hole opposite the end of this stud. Also drill and thread mounting holes at each corner of the base.

On the opposite side of the base piece mount two contact strips. The function of these is to break the electric lamp circuit when the wafer pushes against one of them, or connect the lamp when the wafer contracts and lets the contacts come together. Excellent contact strips can be obtained by tearing apart an old telephone jack, such as you can pick up at a radio repair store or other place where junked radio equipment is available. These strips are provided already with contacts that produce a minimum of sparking. Flatten the end of the longer strip if it is bent, drill a hole near that end,

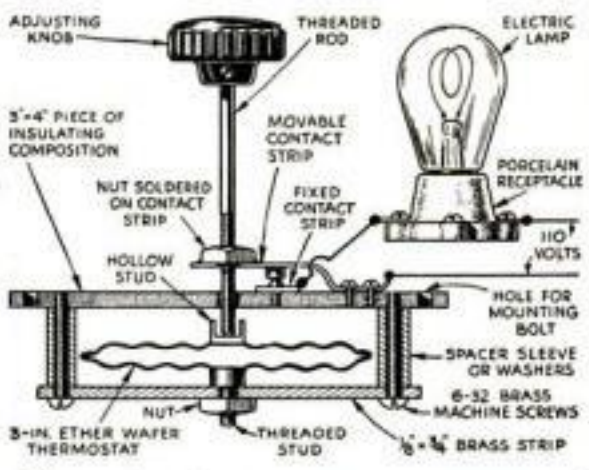


Diagram showing how thermostat is arranged. The ether-wafer unit expands when heated

and solder over it a 6-32 nut. By means of the two holes already in the strip near the opposite end, fasten the piece to the insulating base so that the nut is directly opposite the hollow stud on the thermostat disk. Arrange the other contact strip so that its contact point lies directly beneath that of the first strip. Run a bolt through the soldered nut, and turn it down until it presses against the bottom of the hole in the thermostat disk stud. This bolt should be long enough to project through the top of the incubator cabinet and receive an insulated radio knob.

Heating the ether wafer causes the disk to expand and the hollow-end stud to move outward. This stud presses against the end of the bolt, causing the movable contact strip to bend outward and break the contact. This turns off the lamp. Loss of heat through the walls of the box causes the temperature to drop, the thermostat wafer to contract, and the contact points to come together again. The lamp lights, the disk expands, and breaks the circuit when the predetermined temperature has been reached. When the thermostat is working properly under normal room temperature conditions, the lamp will flash on and off every few seconds. An old-fashioned carbon-filament bulb, although inefficient as a light producer, is perhaps a better source of heat than a modern gas-filled lamp. To make the thermostat break the circuit at a higher temperature, loosen the adjusting screw; at a lower temperature, turn it clockwise.

The lamp is held in a porcelain socket mounted on the floor of the box, in a rear corner. If desired, an asbestos shield can be placed over the wood near the lamp. The thermostat is mounted at the top, to the rear, and on the side opposite the socket. One wire from the source of current goes directly to the lamp; the other goes to one of the thermostat contact strips, and a wire runs from the other *(Continued on page 88)*

INCUBATOR CABINET

(Continued from page 87)

The thermostat wafer is mounted on a metal strip, which is then fastened to the panel

strip to the remaining lamp terminal.

Shelves are made of thin plywood or similar material and are held by slender strips nailed across the sides of the box. Holes are bored in the lower shelves, as shown, to hold test tubes, while the upper shelves are plain. None of the shelves should extend to the rear of the box or be more than about 4 in. wide. This leaves a space at the rear for air circulation. The strips forming the door stops separate the front edges of the shelves from the door sufficiently to permit circulation at the front. Narrow strips tacked or glued along the rear edges of the shelves act as stops to prevent Petri dishes from being pushed back too far.

The temperature of the incubator illustrated varies less than a degree, even with the door open. If you intend to use it for highly exacting work, it might be well to take temperature readings at several points in the interior simultaneously, and make any necessary adjustments of heat distribution by inserting baffles or shields, or by rearranging the thermostat and lamp. There will generally be a slight variation in temperature from bottom to top because of the natural rise of heated air, but for all practical purposes this can be ignored. When putting the incubator into operation and after adjusting the thermostat, allow about fifteen minutes for the temperature to become stable.—M. C. W.

PERFORATED PATTERNS MADE ON A SEWING MACHINE

STENCILS for marking outlines on signs, fretwork, and the like can be made by drawing patterns on light paper and then perforating the lines with a sewing-machine needle. The stencil is placed directly on the work, and the design transferred by applying chalk through the perforations or using a pounce.—ORVILLE KELLMAN.

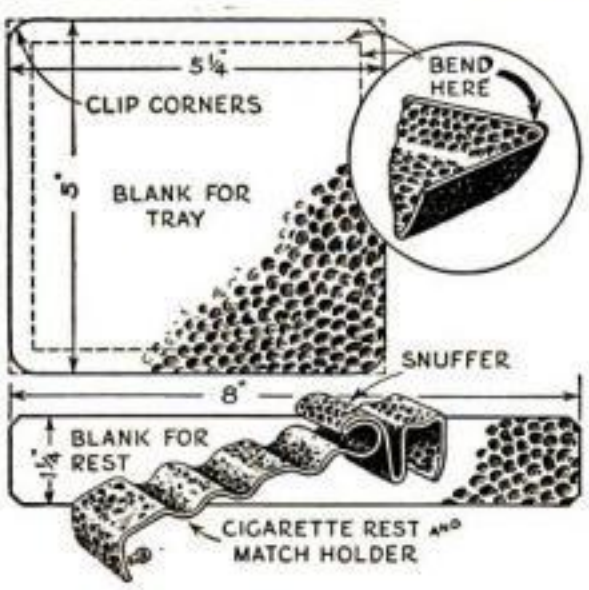
TESTING COLD-ROLLED STEEL

SOME cold-rolled steel—perhaps the majority of that picked up by amateur mechanics in the junk yard—has hard spots in it. These will cause any lathe tool to chatter, no matter how carefully ground and set. It is therefore an excellent plan to test any piece of stock intended to be finished to close limits, by taking a light cut off the outside of the entire length. This will usually reveal any hard spots before a lot of time and work have been wasted.—M. A. COOPER.

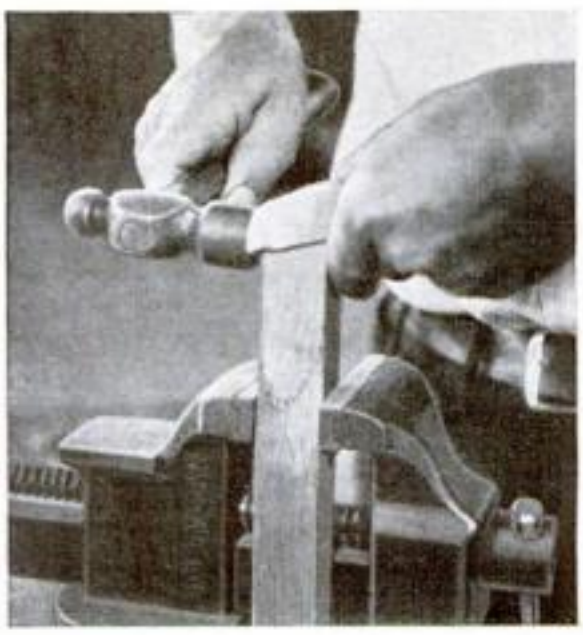
ASH TRAY IS BRIDGED BY CIGARETTE REST

COUNTLESS designs for ash trays have been published, but here is a new and different one that has two distinct advantages. The cigarette rest is placed over the tray in such a way that neither the ashes nor the cigarette itself can possibly fall on the table. There is also a snuffer into which a cigarette may be slipped to put it out. The next cigarette pushed into the snuffer forces the old one out so that it falls into the tray.

From 16-gauge sheet copper, cut out the blank and clip the corners as shown. Anneal by heating to a cherry red. After cooling, shape it as far as possible by hammering on the inside, bending the sides up to form a boxlike tray. It is then best to use a square, hardwood block in the vise to finish the shaping. Place the tray over one corner of the block and hammer *(Continued on page 90)*



The blanks for the two parts and how they are bent before being riveted or soldered



The shaping of the tray is finished by hammering it over a hardwood block in the vise

NOVEL COPPER ASH TRAY

(Continued from page 89)

in the sides and corners in the way shown until all are smooth. If the material becomes too hard, repeat the annealing.

The cigarette rest is cut a little longer than shown, as the surplus may be removed after the shaping is completed. This piece also should be very soft. Double the metal tightly 3¼ in. from one end; then form the snuffer around a ⅜-in. rod. The remainder of the short end forms the match holder and is shaped with pliers. It will hold either box or book matches. The cigarette rests are all formed over the ⅜-in. rod, and the balance of the shaping is done with the pliers.

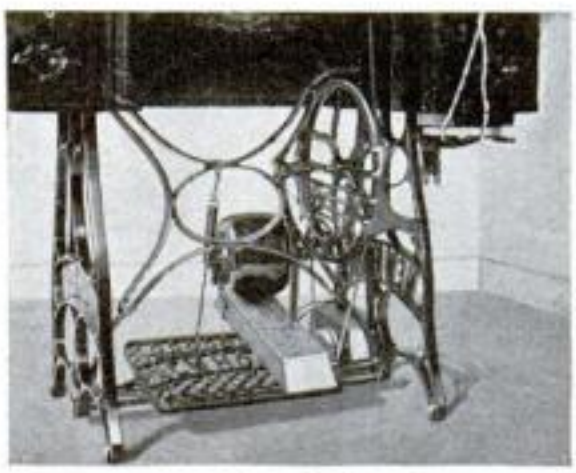
Drill two holes in each end, and corresponding holes in the sides of the tray. Rivet the parts with escutcheon pins, unless you prefer to solder the piece.

Dissolve a small piece of liver of sulphur in about a quart of water; then, after washing the tray thoroughly with soap and water, immerse it in the solution and leave until it turns brown. Remove and wash it, polish well, and apply lacquer.—DICK HUTCHINSON.

What types of decorative metal work are you especially interested in? Send a post card to the Home Workshop Department listing any projects you wish published in future issues.

FAN MOTOR RUNS OLD SEWING MACHINE

HOW I utilized a fan-motor to drive a foot-power sewing machine is illustrated in the accompanying photograph. I removed the guards and fan from a two-speed 12-in. fan and put on a small grooved pulley, obtained from the dealer who sold me the fan. Then I took the motor off its base and set the lower neck part into a tapered hole in a short piece of "two by six." This was bolted to the top of the sewing machine treadle with a light brace to the top of the motor to hold



An emergency method of using a fan motor to drive an old-style foot-power sewing machine

it from twisting. Next I removed the treadle rod or pitman, clamped a grooved wooden pulley below the sewing machine belt wheel, and lengthened the belt so that it would go down over the lower pulley, as shown. The two-speed switch was removed from the base of the motor and installed under the right-hand machine drawer. The spring at the rear normally holds the motor pulley just clear of the belt.

To operate, the switch is turned to high or low speed as best suits the work, and the treadle pushed down at the rear until the pulley on the motor is held firmly against the belt.—I. W. DICKERSON.

NONRUSTING SCREW THREADS

WHEN using screws on outdoor furniture, rub white lead on the threads. They will be much easier to drive and will not rust or come out.—BENJAMIN W. HICKS.

HOW TO MARK GRADES ON PHOTO-PAPER PACKAGES

When several packages of photographic printing papers are opened for use at one time, as when negatives of varying degrees of contrast are to be printed, there is danger of mixing up the packages because the inner black envelopes are not marked in any way to identify them. This often causes confusion.

Upon opening the outside packages, mark the respective grades of contrast upon the inner black envelopes with a white pencil such as is sold by stationers for writing on the black pages of photo albums. This will unmistakably identify the various packages, even in a weak safe light.—C. Edward Lindberg.

PLACING WHITE TITLES ON PHOTO PRINTS

Titles or other information may be written on prints with a clean steel pen and a saturated solution of potassium bichromate. In this process, the writing upon the print becomes a part of the regular printing procedure, since the bichromate is not effective upon prints that have been already developed.

Set the negative in the printing frame in the regular manner. Temporarily locate the sensitized printing paper to get an accurate idea as to just where you desire the writing to be, taking care to avoid extreme high-light locations. Then remove the paper and write the desired inscription upon the sensitive side of the paper. Blotting paper can be used to hasten the drying. Let the paper stand a minute or two to insure that the writing is dry. Then print and develop in the regular manner. The written inscription will appear a crisp white.

In case many prints are made from the same negative, it is advisable to place a sheet of clean transparent cellulose between the negative and printing paper to avoid the possibility that any damp bichromate solution will be deposited upon the negative and show on the next print.—Daniel J. Egan.

PULLING LEAD-COVERED CABLES

Electrical workers are warned so often against the use of oils and greases as lubricants in pulling wire that they often lose sight of the fact that grease can be used to great advantage in pulling lead-covered cables into conduit. Heavy cup grease can be generously applied to lead cables without damage to the cable, and it greatly lessens the effort required in pulling.—L. N. G.

We'll help you start a HOME WORKSHOP CLUB

With fall approaching, this is the best time to start a home workshop club in your own community. A club will double the pleasure you get out of your hobby. That has been proved by the experience of the 180 clubs already affiliated with the National Homeworkshop Guild. Send a large self-addressed and stamped envelope for full information.

PLANS FOR BUILDING A HAND LOOM

(Continued from page 67)

the photographs, assembly drawings, and detail drawings. It is, therefore, quite simple to make comparisons and clear up any difficulties as the work progresses.

The wood used for the loom illustrated was birch. Maple may be used. A list of materials is given below to aid in purchasing. The iron parts, with the exception of the pawl, are castings, and wooden patterns must be made either by the builder of the loom or by a pattern maker in the foundry where they are to be cast. The pawl may be made by a local blacksmith.

The frame of the loom is mortised and tenoned together. Each side is assembled with permanent joints, *(Continued on page 93)*

List of Materials for Four-Treadle Hand Loom

A. 1 pc. 1½" x 1½" x 49½"
B. 2 pc. ¾" x 1" x 30"
C. 1 pc. 1½" x 1¾" x 46½"
D. 1¼" x 1½" x 49½"
E. 1 pc. 1½" x 2¼" x 44"
Raddle, 1 pc. 1½" x 2¼" x 44"
F. 2 pc. 1¾" x 3½" x 28½"
G. 2 pc. 1¾" x 3" x 48"
H. 4 pc. 1¼" x 2¾" x 22¼"
I. 8 pc. ⅜" x 1" x 40"
J. 2 pc. ½" x ½" x 40"
K. 2 pc. 1¾" x 3½" x 32¾"
L. 2 pc. 1¾" x 3" x 32¾"
M. 2 pc. 1¾" x 3½" x 48½"
N. 2 pc. 1¾" x 3½" x 28½"
O. 1 pc. 1½" x 1½" x 44"
P. 1 pc. 1¾" x 3½" x 48"
Q. 2 pc. 1¼" x 1¾" x 17"
R. Cast-iron fulcrum, 2 req'd (see detail).
S. 4 pc. 1" x 1" x 40"
T. 2 pc. 1¾" x 3½" x 12"
U. 1 pc. 3¾" diam. x 45½"
Cloth beam, 1 pc. 3" diam. x 46"
V. 1 pc. 1½" x 5½" diam.
W. 1 pc. 1½" x 6" diam.
X. 1½" x 1½" x 13½"
Y. 1 pc. 1½" x 1½" x 15"
Z. Reeds—One 17-dent reed 40" long and one 24-dent reed 40" long.
Dowels—¼" and ½"
Ratchet wheel, cast iron, 1 req'd, (see detail, Fig. 23) drilled and countersunk.
Pawl, wrought iron, 1 req'd (see detail Fig. 24).
Rack teeth, cast iron, 2 req'd (see detail, Fig. 26).
Carriage bolts, 4 req'd, ⅜" x 6".
Canvas, 1 1/6 yds. 40" wide.
Small metal plate, drilled and countersunk for screws (see Fig. 22).
Wire pins, 2 req'd (see detail, Fig. 27).
Shuttles, 3 or more req'd (see detail, Fig. 28). The stock for these is 3/16" x 1" x 17".
Canvas sticks, 2 pc. ¼" x 1" x 40" (see Figs. 29 and 30).
Cotton twine, 1 ball, ⅛" diam.
Screw pulleys, 2 req'd, wheels 2" diam. (see Figs. 4 and 5).
Awning pulleys, 4 req'd, 1" single.
Awning pulleys, 4 req'd, 2" double.
Screw eyes, 32 req'd, ⅜" eye.
Heddles, 1,200 (300 to each heddle frame).
Iron butt hinges, 4 req'd, 2" x 2½" with leaves opened.
Handles for ratchet wheel, 2 pc. ¾" x 1" x 10".
Wedge-shaped keys, 6 pc. ¾" x 1" x 4".

PLANS FOR BUILDING A HAND LOOM

(Continued from page 92)

Fig. 3. View showing loom from the rear

but the cross stretchers *G* and *P* and the cloth and warp beams are removable. This is a necessary form of construction, because the loom is too wide to go through an ordinary doorway without being taken apart.

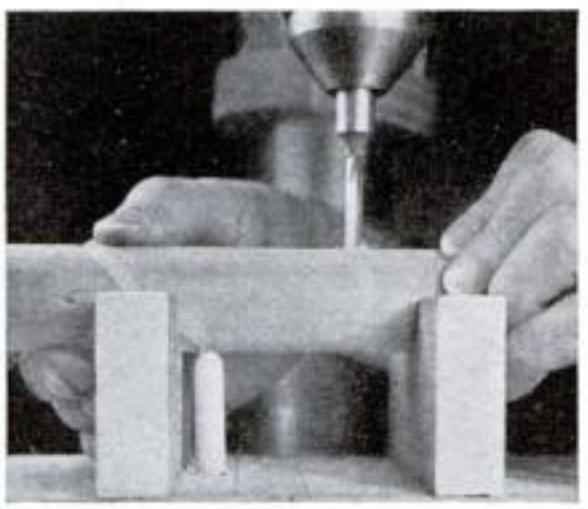
The cord used in the harness is a strong, twisted cotton twine, about ⅛ in. in diameter.

The raddle, shown in Fig. 31, is a contrivance used in place of the breast beam when threading up the loom, to regulate and space the threads as they are being rolled on the warp beam.

The rack teeth permit the beater frame to be moved back to suit the convenience of the operator as the cloth is being woven.

The cost of the materials for this light, efficient loom was about $30, including wood, pulleys, canvas, and castings.

ORNAMENTAL SPIRALS CUT ON DRILL PRESS



LARGE wood dowels, curtain poles, and other rods can be routed on the drill press to give a true spiral effect for decorative purposes. The illustration shows the rig, or cradle, for holding the poles steady. A wood pin set in the baseboard engages the routed spiral after the first inch has been made by means of a pencil layout, and thereafter it is necessary only to turn and push the pole until it has been routed for its entire length. So that the pin will engage the routing as soon as possible, the rig should be adjusted to right or left as is necessary. It is then held on the drill-press table with C-clamps. When a number of rods are to be prepared, the end of one can be temporarily fastened to the next so as to eliminate laying out the starting point on all but the first pole.—EDWARD V. BURNHAM.

MICROSCOPIC PLANTS OFFER RARE BEAUTIES

(Continued from page 45)

largely to the presence of imprisoned, colored algae which were growing at one time in the waters of the springs, even though those waters were hot. Some of the plants live in water at 155 to 170 degrees Fahrenheit; others exist in snow and ice!

Whatever the visible color of the algal cell, there is always present the familiar green chlorophyll. This material plays an important, though not completely understood, part with the aid of sunlight in the conversion of raw materials such as water and carbon dioxide into food for the cell.

IF YOU find, in a stagnant pool, on a tree trunk, or wherever there is moisture, some blue-green algae, you can try an interesting experiment that will prove that the plant is, at heart, green in color. Fill a test tube half full of water, and into it introduce several drops of chloroform. Shake the tube vigorously, to mix the two liquids. Then let it stand until the chloroform settles to the bottom. Carefully pour off most of the water, and into it place a quantity of the blue-green algae.

The chloroform-water extracts the blue coloring matter, called phycocyanin, leaving the algae bright-green in color. Instead of chloroform-water, you can use water to which a few drops of carbon bisulphide has been added. In trying this experiment, examine the algae with the microscope before extracting the coloring matter and again after it has been extracted.

Let's return for a moment to some of the specimens collected on the field expedition. Here is that bright-green substance taken, with the glass dipping tube, from the bottom of the pools along the creek.

Under the microscope the long, green fibers become chains of cylindrical, smooth-walled cells whose contents are most striking in appearance. Particularly toward the rounded ends of the strands is the formation distinct. The cells seem to be filled with spiral chains of green beads. This appearance is caused by the shape of the brilliant green chromatophores through which are scattered the bead-like pyrenoids. This plant is the well-known Spirogyra.

The mass of threadlike algae gathered from the lake is seen to be a collection of several different kinds, all growing in long filaments. Some have cells in which the chromatophores are arranged like delicate nets. In others, the green material is collected in a compact mass near the cell center. In still others, each cell contains a pair of star-shaped chromatophores, with a bead (pyrenoid) in the center of each star.

THE green mat obtained from the tropical-fish tank seems to be made up almost entirely of *Pithophora kewensis*. The normal cells are shaped like long cylinders, with the green material strung through them like shapeless nets. Here and there can be seen dense, swollen cells. These are the resting spores or akinetes.

This examination of easily found algae could go on for a long time, for a whole lifetime, before all members of the vast family became familiar. You can find algae growing in almost every imaginable shape—filaments; beadlike strings of cells; nets made of long, slender cells joined together to resemble chicken wire; stars; crescents; spirals; tiny balls; spiny balls; complex balls made up of many cells such as Volvox; and so on and on.

There is, however one specimen bottle we must investigate more closely. It contains some of the muddy water collected from the creek where the expedition stopped first. The magic lenses of the microscope convert a little, muddy smear, (Continued on page 95)

MICROSCOPIC PLANTS OFFER RARE BEAUTIES

(Continued from page 94)

made by placing on a slide a bit of the mud that settled to the bottom of the bottle, into an amazing collection of tiny objects. Prominent among them are minute green forms of most unusual beauty, which travel about with somewhat erratic movements. Plant or animal? Like plants they are green, yet they move like animals.

Again to the botany book, to verify a suspicion. Yes, they are fairy plants—diatoms. And here, again, the plant explorer is up against a kingdom so vast that a lifetime would be required to master it. There are microscopists who specialize in diatoms and spend all their lives studying them, without ever seeing many of the forms that exist.

MICROSCOPISTS, especially when their experience is not extensive, frequently confuse diatoms and their brothers, the desmids, for they are in many respects similar. The desmids are mostly one-celled plants that float about in fresh-water ponds or collect on margins and bottoms. They are beautiful in shape, and their cellulose surfaces frequently are figured with spines, dots, and stripes. One characteristic of a desmid, and one that helps in identifying it, is its symmetry. In other words, it consists of two halves, one of which is like a mirror image of the other. Between these two halves, there is usually a constricted zone containing the nucleus.

The diatoms, essentially like the desmids in that they are one-celled plants with highly sculptured walls, are also symmetrical; but their symmetry is not always of the mirror-image type. In the diatom, nature reaches an amazingly high degree of delicacy in the matter of sculptured design. The cellulose walls of the diatom cell are so heavily infiltrated with silica, or natural glass, that they are rendered virtually everlasting. These silica skeletons frequently are most beautifully decorated with raised ribs, sunken pits, pores, slits, and mosaic patterns.

You can find diatoms in almost any pond, stream, lake, or even a roadside ditch that has had water in it for several days. They usually collect on the bottom, so that, by scraping off a bit of the top layer of silt, you can obtain hundreds of specimens. Farther down, if the pond is an old one, you can find deposits containing nothing but the silica skeletons of diatoms. In some parts of the earth are beds of diatomaceous earth that is used commercially for polishing various materials. Some toothpastes and powders contain diatom skeletons millions of years old.

The living diatom usually exists as an isolated cell but sometimes is joined with others to form a filament. It is a typical one-celled plant, brownish-yellow with chromatophores, and has, of course, a nucleus. Movement is accomplished by waving, hairlike cilia which project through the openings in the glass skeletons.

IF YOU wish to preserve silica diatom skeletons, which to the microscopist are the most interesting parts of these enchanting plants, it is not a difficult matter to remove the cell contents. Simply place the diatoms in a test tube containing a little strong nitric acid, heat the liquid and allow it to boil for a time, being careful not to get the hot acid on your skin or clothing. Then carefully pour off the acid after the solid particles have settled, and wash the silica skeletons thoroughly. Dry them by heating gently, and mount under a cover glass.

Some workers like to have the skeletons mounted in air rather than in balsam. This can be done by making a cell on the slide, coating the bottom with a very thin layer of balsam, and letting *(Continued on page 99)*

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Secrets of Success

STORIES THAT WILL HELP YOU GET AHEAD

PEPS UP THE HOTEL BUSINESS

A LITTLE over two years ago, while on my way to the West Coast to cover a series of spot news assignments, I changed trains at Chicago and slipped down into Illinois to have a chat with Fred Winters, an old school chum I hadn't seen in years.

When I last visited Fred in 1928 he and his wife were happily ensconced in a small cottage just outside the town.

Coming down on the train I looked forward to a happy repetition of my last visit, but my hopes were sadly shattered. Fred, I learned, no longer owned the cottage—the sheriff did—and Fred, the free-spending, successful Fred I had known, was existing upon the goodness of the local community chest and whatever odd jobs he could command.

It didn't take Fred long to describe his sudden fall. The engineering firm with which he had been employed was, like many of its kind, forced to retrench soon after the crash in '29. They honestly didn't want to lose a man as good as Fred, but depression was depression and even at that, they gave him a bonus, plus his month's salary.

Back at the hotel I thought about Fred's predicament. He was the executive type, a hard-worker and chockful of ideas . . . and that gave me an idea.

I rang for house service and arranged a talk with the hotel manager. Two minutes later I was in his office.

"Yes, I know Winters," said the manager. "He often came here for dinner."

"Could you use a man like him?" I asked.

"Well . . ." the manager hesitated.

"Well?" I prodded.

"Yes, if he were acquainted with hotel business," he said, "but I couldn't agree on any salary until he proved he was worth something. . . ."

"Exactly," I replied.

The next day I had a long talk with Fred and his wife.

It wasn't that the job was worth much. It was merely the fact that here, at last, Fred was offered an opportunity to show what he could do.

"But what do I know about hotels?" he protested.

"That's the point," I said.

That night Fred and I went to the telegraph office and sent off the first payment on a home study course in hotel management.

The next morning he reported to the hotel manager and began work WITHOUT PAY! The manager agreed, however, to place Fred on the payroll the moment he showed what he could do and meanwhile, he offered Fred a small suite and meals for his services.

It was a gambling chance . . . but Fred had ideas, a capacity for management and

Secrets of Success

with an old-fashioned hotel to work on, an opportunity.

Three months later I received a letter from Fred's wife, Helen:

". . . . . I'm writing this because Fred is too busy to . . . . One month after he completed the management course he landed a big piece of publicity for the hotel in the local paper . . . He has cut operating costs and now he has just argued the owner into rigging up a sidewalk service with a canopy . . . This all thanks to you and . . . the course."

Helen didn't owe me any thanks, neither did Fred. It was just a case of bringing new life into a slightly antiquated hotel when shown how by someone who knew how the modern hostelry should be managed.—J. C., Astoria, N. Y.

AIRPLANE PHOTOGRAPHY SPECIALIST

COMPLETE success doesn't come very early, but twenty-year old Robert Hare, Los Angeles, Calif., has at least found a way to earn his college money and a profession to follow after graduation.

Robert became interested in photography several years ago as a hobby, and as airplanes had always fascinated him when a youngster, they naturally became the subject for most of his photographs.

In school he studied journalism and decided to make writing his life career. But airplane photography still remained his chief interest and in conjunction with the many pictures he took, a collection of World War airplane photos was begun. To obtain many of these pictures he began corresponding with a number of famous war-time flyers in Germany, Great Britain, France, Australia, and the United States. In exchange for their photos Robert would send them shots of the latest American planes.

You perhaps wonder how this could turn into anything profitable. But Robert next began to write airplane feature stories for a model airplane magazine. To successfully sell these stories it was necessary to colorfully illustrate them with interesting photographs.

To illustrate the war stories he had the pictures the veteran pilots had sent him. But for the stories about modern aircraft he found he must make his photographs vivid and stand out. In order to do so he spent all his spare time studying photography courses. It was easy enough to take just snapshots, but to take pictures with news value and contrast, such as magazine editors wanted, was not so simple. The only way was to follow instructions of those who were authorities at the game.

Since he has learned to take newsy pictures he has sold a number of illustrated aeronautical articles to magazines and has made several hundred dollars in this work in little over a year. He recently sold some photos of commercial aircraft to an English magazine.

During the National Air Races in Los Angeles he took over seventy-five photos. Many of them he did not print but all the negatives are arranged in a file for some

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future use. In this same case he has filed away over a thousand negatives of airships he has snapped in the past three years. When the necessity arises for one of these he can immediately make the print and deliver it.

Robert believes in spending part of the money he makes in buying the latest equipment he can afford, and has purchased a new camera with very fast lenses, which takes inexpensive small pictures.

Besides the air photos he has also taken some shots of college scenes which he has sold to several college publications. —P.B., Los Angeles, Calif.

NEW CASH PRIZE OFFER

$5

for every letter we print on the subject, "What Home Study Has Meant to Me."

During the past few months, Secrets of Success has published numerous stories of men who have achieved places of importance in business and industry because they planned their careers and prepared themselves for advancement by spare-time study at home. We know that among the readers of POPULAR SCIENCE MONTHLY there are many other men whose accomplishments are just as interesting, just as inspiring, and for the same reasons.

If you have "arrived," write and tell us about it; not just for the prize alone but that your success may spur on some one else to bigger and better things. As stated above, we will pay $5 in cash for every such letter we publish, but if preferred, the winners may elect to take a 4-year subscription to POPULAR SCIENCE MONTHLY instead.

Only letters from bonafide home study school students will be considered and these must contain the name of the school and the name of the company, or companies, for whom you have worked since graduation. (Names, however, will be deleted from the letters when published.) We also want to know the kind of course you took and the type of positions you have held. Your own identity will be kept anonymous, if desired.

We are interested in facts, not literary ability, but please write clearly, completely, and keep your letter within 500 words. We are not looking for "get-rich-quick" stories or freak adventures, and authors must be prepared to substantiate the truth of their statements. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless sufficient postage is provided for this purpose. Address your contribution to Success Story Department, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, N. Y.

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MICROSCOPIC PLANTS OFFER RARE BEAUTIES

(Continued from page 95)

it dry. Scatter the diatoms over it, warm the slide gently to make the balsam tacky enough to cause the specimens to adhere, and then apply the cover glass. Special mounting materials for diatoms are available.

There has been developed, in Germany, an embedding material intended to make algae easier to examine with the microscope. The usual mounting medium for microscopic objects is transparent, Canada balsam being an example. This new algae-embedding material, however, is black in color. The specimen to be mounted is first fixed and completely dehydrated by the usual methods. Then it is arranged on a clean slide, a drop of the embedding material added, and the cover glass pressed in place in such a manner that all the air bubbles are excluded. The glass is pressed down until the specimen rests against both cover and slide.

WHEN the slide is examined, the dark-colored mounting medium reduces the amount of light that otherwise would pass *around* the algae, but lets light from the microscope mirror pass *through* it. The result is a surprisingly distinct image, in which detail otherwise invisible is seen clearly. The mounting material is also being used for other objects, such as wool fibers.

For permanent mounting, algae must be fixed and, generally, dehydrated. A suitable fixing agent is weak chrome-acetic acid solution, made up as follows: one-percent solution of chromic acid, twenty-five cc; one percent solution of acetic acid, ten cc; distilled water sixty-five cc. An ordinary eight-ounce drinking glass contains approximately 240 cubic centimeters.

Leave the specimens in this fixer for two to twelve hours, or longer if they will stand it. Next, wash thoroughly in running water. An easy way to do this is to put the fixed algae into a tall glass tumbler, tie over it a piece of cheesecloth, punch a small hole in the cloth near the edge, and insert a glass tube connected to the water supply. Water entering through the tube escapes over the tumbler edges, the cloth holding the algae back. It is best to wash the specimens for several hours in this way.

After this, they can be stained and mounted in glycerin, or dehydrated by leaving them for an hour in fifteen-percent alcohol, a similar time in twenty-five-percent alcohol, and for about two hours successively in thirty-five-percent, fifty-percent, and seventy-percent alcohol. For indefinite preservation in alcohol, an eighty-five-percent solution can be used. Final dehydration is done by leaving the material several hours in ninety-five-percent alcohol, followed by thirty minutes to an hour in absolute alcohol. They are then mounted in balsam or the special, dark-colored algae-embedding medium.

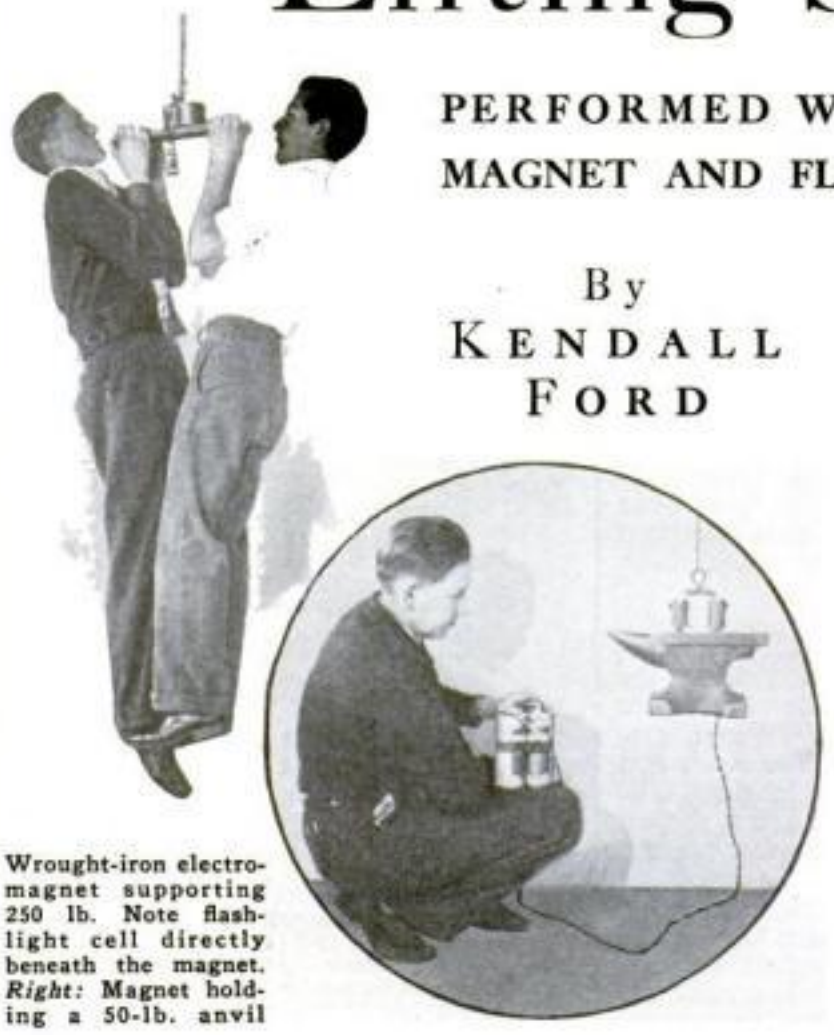
ALTHOUGH algae are of great interest to the microscopist and the botanist, from a commercial standpoint they are not exceptionally valuable. Diatomaceous earth or kieselguhr is used for scouring and polishing. Some marine forms of algae, such as the kelps whose strands reach 700 feet in length, are sources of iodine and agar-agar, the latter used in certain medical preparations, in making Oriental soups and jellies, and for growing bacteria.

On the whole, you will find the kingdom of fairy plants one of the most fascinating in which you can browse with your microscope. You can learn much about all plant life by studying these simple forms. You can get lessons in beauty such as you will find in no other way. Doubtless many designers already have discovered and been inspired by this store of beauty hidden from the naked eye.

Lifting Stunts

PERFORMED WITH ELECTRO-MAGNET AND FLASH-LIGHT CELL

By KENDALL FORD



Wrought-iron electromagnet supporting 250 lb. Note flash-light cell directly beneath the magnet. *Right:* Magnet holding a 50-lb. anvil

A STUNT that never fails to bring gasps of wonder from the layman is to connect a single pencil flash-light cell to a powerful homemade electromagnet and have it support the weight of two boys or men. Actually, the magnet will have the same lifting power and consume the amount of current regardless of the size of the dry cell, but the uninformed will usually associate a minute amount of electricity with a cell of such small proportions. The cell, of course, should be connected to the magnet only when actually in use as its current capacity is limited.

The magnet marked No. 2 in the drawings is capable of sustaining 250 lb. on a single flash-light cell. The current consumption is .6 ampere.

The shell is 4-in. black iron pipe, turned to a length of 2 in. in a lathe. It is essential that the ends be turned perfectly true. A wrought or soft iron plate ¼ in. thick and 4½ in. in diameter is drilled as shown, and corresponding holes are drilled in one end of the pipe, to which the plate is fastened with machine screws.

The core is a piece of soft iron, turned to size, drilled, and tapped as indicated. This is fastened to the top plate with an eyebolt, which is made from a piece of ⅜-in. round iron, threaded on one end. The assembled magnet shell is now placed in the lathe and the end of the core faced off true with the edge of the pipe. If desired, the whole magnet shell may be turned from one solid piece of wrought iron.

A fiber terminal strip, as shown in the detail, is made and fastened to the top plate with a machine screw. The binding screws should be countersunk into the strip so that they will not touch the top plate.

About 1 lb. of No. 18 double cotton-covered wire will be required. This may be wound on a wooden form and afterwards wrapped with tape (see P. S.M., June '34, p. 80) or on a copper or brass form made as shown. A tin or sheet-iron form cannot be used. If the metal form is used, the completely wound form is slipped in place over the core. The ends of the coil are brought through the holes drilled on each side of the terminal strip. These holes must be insulated with fiber tubing.

A brass or copper retaining plate with a hole cut out for the core is pressed into the magnet shell to hold the coil in place.

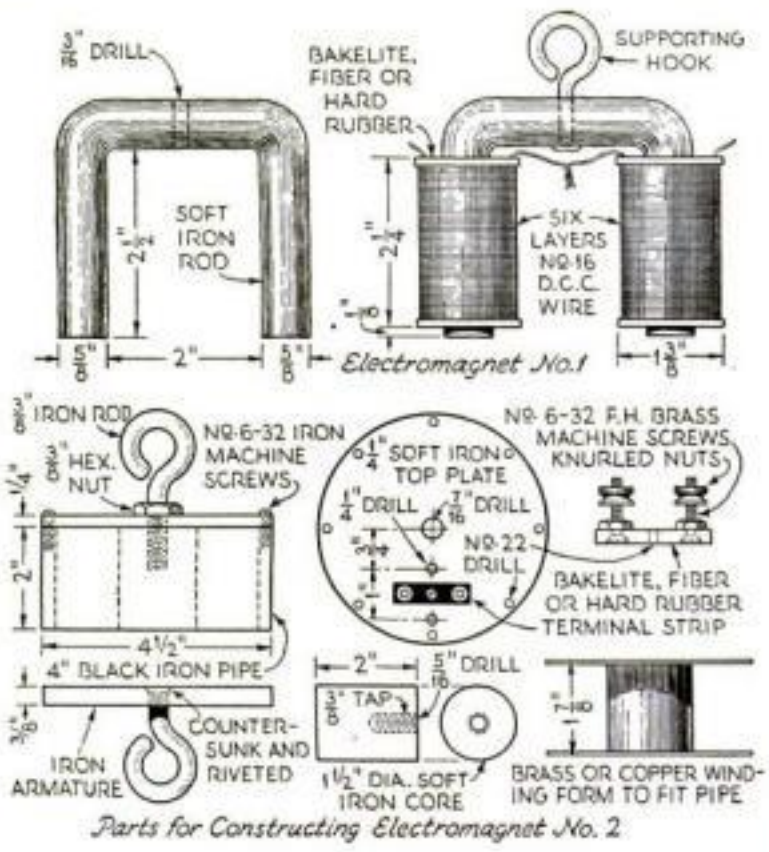
To obtain the greatest efficiency from the magnet, an armature plate should be made as shown. Its surface should be perfectly smooth and true so that it will make good contact with the magnet.

If the magnet shell were made of cast steel, it would support a weight of 500 lb., since the magnetic qualities of cast steel are greater than those of wrought iron. Cast iron is the poorest.

The magnet marked No. 1 is easier to make, but somewhat less efficient. When connected with two dry cells, it will support 50 lb. on a current consumption of 4 amperes.

Bend a piece of ⅝-in. soft iron rod, 7 in. long, to the shape shown, and drill a hole for the supporting hook. It is advisable to heat the iron before bending. If ⅝-in. iron is not available, a slightly larger or smaller size may be substituted if the holes in the end washers are changed accordingly.

Place four insulating washers on the iron

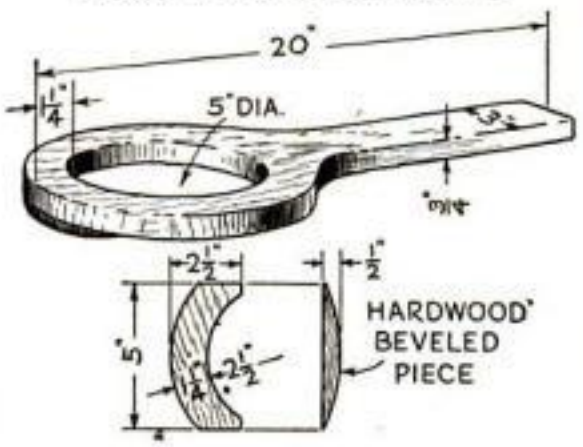


A variety of small, powerful electromagnets

core, and wind six layers of No. 16 double cotton-covered wire on each leg. Wind each coil in the same direction and connect the inside wires. An alternate method of winding would be to wind each coil in the opposite direction and connect an inside and an outside wire, but the former provides a neater connection. The wires should be brought through small holes drilled in the insulating washers. Flexible leads connected to the ends of the coils will greatly facilitate the use of the magnet and lessen the possibility of the leads breaking off where they come through the washers.

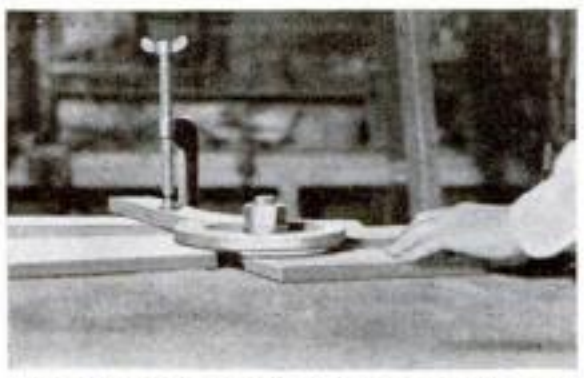
The parts used in the magnet marked No. 2

GUARD AND HOLD-DOWN FOR WOOD SHAPER



The guard is sawed from heavy plywood and has a beveled block glued underneath in front

IF YOU own an old-fashioned or unguarded wood shaper, you should make a combination guard and hold-down to prevent the possibility of a serious accident. A suitable guard can be made by cutting a piece of ¾-in. plywood to the shape shown. A small beveled piece of hardwood is glued on the underside at the round end. In use, the guard is fastened to the shaper table with a large C-clamp so that the hole is centered over the shaper blade.—J. P. K.



Using a wood shaper of old-fashioned type with a homemade guard encircling the cutters

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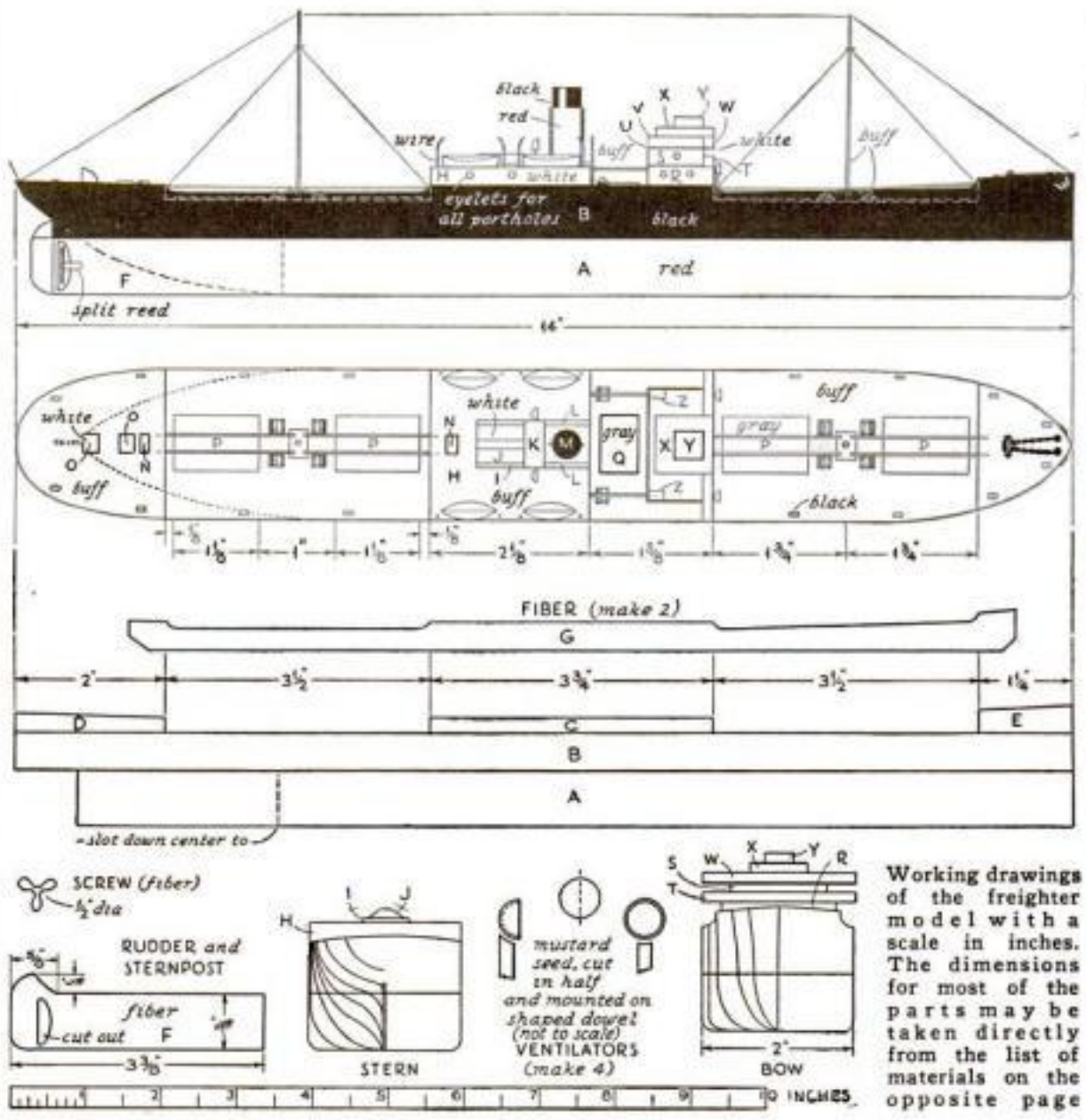
PICTURESQUE FREIGHTER MODEL

(Continued from page 57)



Working drawings of the freighter model with a scale in inches. The dimensions for most of the parts may be taken directly from the list of materials on the opposite page

and, using wood filler or a plastic wood composition, shape the hull where *F* joins *A* and *B*. Make the propeller shaft by attaching two short pieces of split dowel or split reed to *F*, and attach the screw to the hub. Remove *A* and *F* from *B* and paint them red.

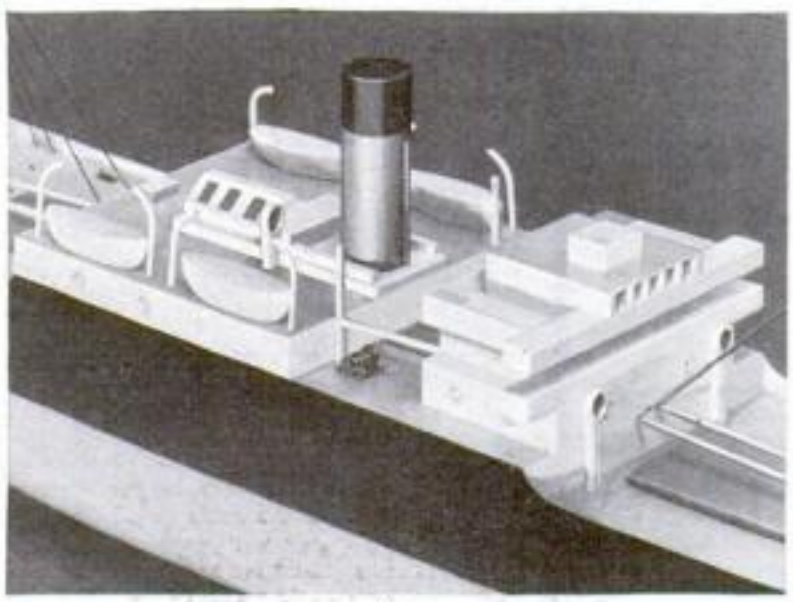
Proceed with the upper portion of the hull by gluing the fiber gunwales or bulwarks to the sides of *B*. When thoroughly dried, sandpaper the edges so that the fiber and wood join smoothly. Now paint the sides black, the decks buff, and the edges of *C*, *D*, and *E* facing the decks, white.

Cut the remaining pieces to shape and assemble and paint the various units separately before attaching them to one another and the hull. Most pieces are already shaped when cut to the dimensions specified in the list of materials. Wherever possible, paint each piece before attaching it to another of a different color. For instance, do not attach the lifeboats to the deck of *H* until each has been painted its own color.

The winches are made by gluing an eyelet and a short piece of wire to a cardboard base about 3/16 in. square, and then painting the unit black. The windlass is of similar construction except that two eyelets are slipped over a piece of wire to form the drum, whereas one eyelet suffices for each winch. The hawse-pipe lips, too, are eyelets, as are all the portholes. The anchors can be cut from card or fiber, painted black, and glued in place. Short lengths of fine chain, such as used in cheap jewelry, add a realistic touch when stretched from windlass to hawse-pipe lips.

The masts are round wood, tapered slightly with sandpaper. These must be inserted absolutely vertical. The derrick booms are long pins with heads removed, inserted into the wood to get their support, though seemingly suspended and attached to the masts. The gravity tanks *Z* support rail *V* around the bridge house.

Ventilators are usually difficult to reproduce realistically. *(Continued on page 103)*



A close-up of the midship section showing the superstructure. Note the ventilators, made from the shells of mustard seeds

FREIGHTER MODEL

(Continued from page 102)

However, by halving well-formed mustard seeds of suitable size, removing the centers, and mounting the resulting half shells on shaped dowels, excellent ventilators can be prepared. The bollards are made simply by gluing small pieces of black paper to the deck, and driving two short pieces of wire through the paper and into the hull. The protruding wire is then touched lightly with black paint.

The rigging follows the usual lines as shown in the drawing. The ends are held down by small pins driven into the hull and painted over to match the deck.

If you intend mounting the model on a base, it is well to nail the underwater portion first, driving the nails through piece *A* into the base. The upper portion of the model can then be set and glued on *A*, and short dowels may be used for additional security, if desired.

List of Materials

WHITE PINE, BASSWOOD, OR BALSA

No. of Pieces	T.	W.	L.	For
1	¾	2	13¼	A
1	½	2	14	B
1	3/16	2	3¾	C*
1	¼	2	2	D
1	⅜	2	1¼	E
1	¼	2	2⅛	H*
1	1/16	⅝	1½	I*
1	⅛	½	⅝	J
1	⅛	¼	⅝	K*
2	1/16	1/16	⅝	L*
2	1/16	⅛	¼	N*
2	1/16	3/16	¼	O*
4	1/16	¾	1⅛	P*
1	1/16	½	¾	Q*
1	¼	⅜	1½	R*
1	¼	¾	1¼	S*
2	⅛	⅛	2	T & W*
1	⅛	¾	¾	X*
1	⅛	⅜	⅜	Y*
2	⅛	⅛	3/16	Z*
4	⅛	¼	¾	Lifeboats

Note: Items marked with an asterisk(*) require no further cutting or carving.

MISCELLANEOUS

1 pc. ⅜-in. round dowel wood 1 in. long for M.
1 pc. 1/16-in. round dowel wood 7 in. long for masts, ventilators, propeller shaft, etc.
1 pc. fiber about 3 by 12 in. for F and G, anchors, propeller, etc.
1 pc. card ⅜ by 1¼ in. for U.
1 pc. card ⅛ by 3 in. for V.
12 pins, 1⅜ in. long for derrick booms, derrick posts, etc.
About 3 ft. of thin, stiff wire for davits, steam and whistle pipes, bollards, windlass and winches, etc.
30 eyelets for portholes, winches, etc. (very small size).
Some small mustard seeds for ventilator cowls.
About 2 in. fine chain for anchor chains.
Spool of No. 100 black thread.
Black, white, red, and buff paint (or black, white, and red alone can be made to serve as they may be mixed together, white predominating, to give a tint resembling buff). For gray, mix white and black.
Glue or cement.

PENNANTS FOR SHIP MODELS

AFTER building the POPULAR SCIENCE MONTHLY privateer model *Swallow*, I was at a loss for some time as to how to make her red and white pennant, which is about 4 in. long and tapers from ¼ in. wide to a point. I finally obtained a miniature silk American flag a little longer than the pennant, stretched it reasonably taut in such manner that only the long edges touched the supports, and applied a coat of clear varnish to cover an adjacent red and white stripe. After the varnish was dry, I cut the pennant from these two stripes. The varnish prevents fraying.—HARRY J. WALSH.

LONG-RANGE PRUNER MADE FROM JUNK

MADE mainly from spare automobile parts, this pruner has sufficient leverage to cut easily, yet it does not harm the bark as many other types of pruners are likely to do. The main housing is a hollow tube from a steering column, split and bent like a fork at one end. Two blades (in this case mowing-machine blades) are pivoted at their outside corners to the ends of the fork. A radius rod passes through the tube and is pivoted to the inner corners of the blades in such a way that when the rod is drawn through the tube by squeezing the handles together, the blades operate like shears. A valve spring is slipped over the rod between the end of the tubing and the blades to keep the blades open, except when the handles are pressed together, as shown in the accompanying diagram. Keep the blades well sharpened.—PARRIS EMERY.

A powerful pruner for reaching inaccessible branches. The blades are operated like shears when the handles are squeezed

INEXPENSIVE DISAPPEARING STAIRS

AN UNFINISHED attic, with no place to put a permanent stairway, brought the solution shown in the accompanying photographs at a cost much less than the price of ready built disappearing stairs.

The space available determined the dimensions. A trapdoor, shown closed in one picture, was made and hinged at one end so that it would swing down with the stairs. At the free end a sliding spring catch with a ring or loop was placed to lock the door in position, although because of the counterweights the door automatically stays in the closed position unless pulled down. A small stick with a hook in the end is used to pull the trapdoor down. The stick is preferred to a drop cord, since it can be hung behind the hall door when the stairs are up and is out of sight.

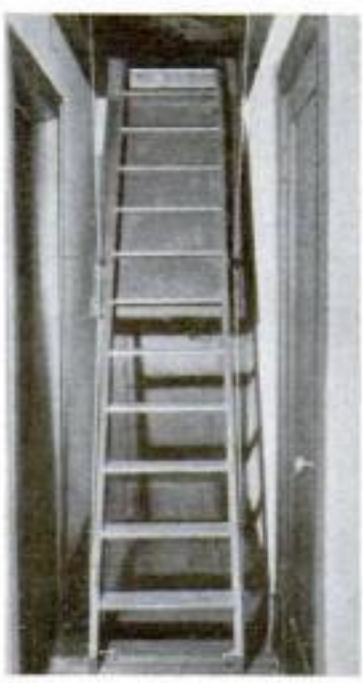
The stairs consist of two sidepieces and steps, the length being determined by the amount of pitch desired, the height of the ceiling, and the space in the attic. The sidepieces slide over a piece of pipe fastened at the head of the stairs, although flat casters mounted with the rollers up would be better. Flat metal strips, which are bent into the form of hooks and set into the underside of the two sidepieces, catch the pipe when the stairs are pulled down and prevent their coming too far.

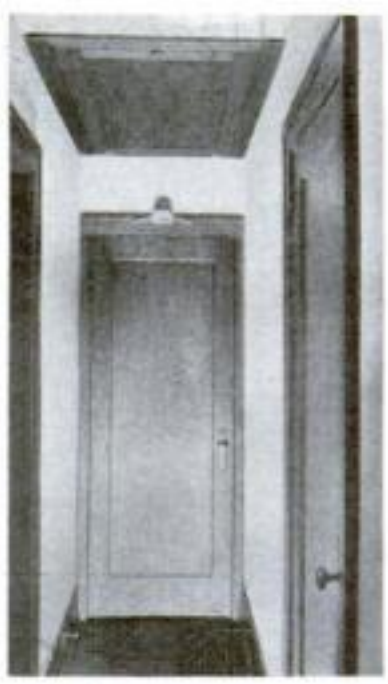
Guide pieces at the top keep the stairs in line, being assisted in this by metal guides on the lower end of the trapdoor. These metal pieces, in addition to keeping the stairs from swinging out of line from side to side, are also bent over the sidepieces of the stairs to keep the trapdoor from dropping away from the stairs.

Heavy sash cords, fastened at the foot of the stairs, extend through pulleys near the lower end of the trapdoor into the attic and over pulleys attached to rafters. At their ends are counterweights, which drop into wells in the partition walls when the stairs are pushed up. The pulleys on the trapdoor are placed far enough from the end so that when the stairs are pushed up, they will swing up into the attic on top of the door without striking the end of the door casing.

The ropes pulling through the pulleys on the trapdoor hold the door close against the stairs so that the metal guides do not wear the sides of the stairs. The stair steps do not extend beyond the back edges of the sidepieces, so do not strike the edge of the trapdoor as the stairs are shoved up from the floor.

The counterweights, if heavy enough, make the lifting of the stairs very easy, and these weights, together with the overbalancing of the upper end of the stairs when pushed up, swing the stairs and trapdoor into position without further effort after the stairs are started up, and the trapdoor thereupon closes automatically. —EUGENE A. HANCOCK.





When pushed upward, the stairs rise into the attic aided by counterweights attached to the cords, and the trapdoor closes

. . .

When tapping bakelite or other soft materials, first tap a steel plate and clamp it in position; then drill through the hole in the plate and use the threads as a guide for the tap itself.—H. C.

IS JUPITER JANITOR OF THE SOLAR SYSTEM?

(Continued from page 39)

level with the top of the mercury column after the bulb has been inserted into the ball.

The result is convincing evidence, I believe, of the truth of Godfrey's theory that Jupiter maintains and periodically raises the sun's heat. When I performed the experiment, there was little change registered in the temperature of the ball's interior for the first two or three minutes of rolling. After this, however, the mercury mounted rapidly and soon showed the ball's center to be ten degrees hotter than at the start of the kneading motion.

WHEN the mercury rises in this simple demonstration of heat production through internal friction, it illustrates what must take place constantly in the sun's interior because of the moving distortion caused by the attraction of Jupiter. In fact, Godfrey tells us that if it were not for this distortion and internal friction, the solar system's apartment in space would be too cold to sustain human life —or any other kind. In other words, the sun, unless constantly "stoked" by Jupiter, would go on forever with "banked fires," leaving its planet family to freeze.

But how does Jupiter, the solar-furnace man, get up a few pounds more of steam which Dr. Abbott's pyrheliometer records at the times of greatest sun-spot activity?

To answer this we must remind ourselves that the gravitational forces between two heavenly bodies vary as they approach or recede from each other. We must also remember that Jupiter, like all the other planets, moves round the sun in an ellipse instead of a circle, with the sun at one of the ellipse's two foci. Jupiter is accordingly about 46,000,000 miles nearer the sun at one part of its orbit, called perihelion. When at its nearest point, the planet brings considerably stronger distorting force to bear on the solar globe, causing great increase in the internal friction and the heat it creates.

To convey some idea of the terrific force which binds Jupiter and the sun together, Godfrey tells us that it would require a solid steel cable averaging 40,000 miles in diameter to sustain the pull! No wonder that even a small increase in this attraction, as Jupiter approaches its perihelion, can account for such extra activity—greater friction and heat generation within the sun, and more sun-spot outbreaks.

As a matter of fact, the greater theoretical heating action of Jupiter on the sun at its nearest approach is remarkably well supported by the facts. Since the number of sun-spots appearing at any one time is a rough measure of the sun's heat output, we can construct a diagram to show Jupiter's effect. This is shown graphically in the record of the maximum and minimum numbers of sun spots counted for fifty years, with a record of Jupiter's perihelions and aphelions running approximately parallel with the respective high and low points of sun-spot activity.

COMPLETE conformity could not be expected, because of a great many other factors, such as the variable "stoking" effect of the eight smaller planets. Their influence is far from negligible. In fact, Godfrey considers the extent to which they reënforce or oppose the pull of Jupiter as responsible for part of the variation in warmth of our summers and winters. The diagrams illustrate this important point.

Further research on the sun's heat, and its variation, is being carried on in various parts of the world and may result in a new explanation—but meanwhile the theory that the planets themselves enforce their demands for more heat upon a reluctant and unwilling sun seems to have much scientific evidence to support it.

Mountain Scenery

FOR MODEL RAILWAYS

TUNNELS, mountains, and hillsides for a model railway that have all the beauty and charm of a natural background can be made of cement and sand.

Two ends for the tunnel are cut out of ½-in. pine with a slope or roll at the top edge to give a natural contour. These are joined with strips of thin wood, after which the entire top and sides are covered with fine wire screening. In place of wire, slate-surfaced roofing material may be used, the chief advantage of which is that it gives a better finish on the inside of the tunnel, if the layout is such that any part of the interior can be seen. A miniature socket is inserted at about the top center, projecting through. It is used to give a camp fire effect.

A stiff mixture of one part cement and two parts screened sand is applied to cover the wire screening. When this mixture has set up, but before it is dry, more of the one-to-two mixture is prepared of such a density that it will remain in any shape. The first coat is covered with this, and the roads, brooks, rocks, and other features of the mountain scenery are formed. Even the little cabins along the roadside may be made of it, unless houses are available such as those used in Japanese dish gardens.

Trees and bushes are pieces of a sponge soaked in water and embedded in wet cement. For larger models, pine cones, painted green and tipped off with red, yellow, or white, may be used. They make more realistic bushes than sponges do. A road winding up the mountain can be made to stand out by imbedding white pebbles in the wet cement.

After this mixture has set, so there is no danger of its sliding, certain parts are given a cement stucco finish by mixing clear cement with water to the density of thick cream and spattering on with a whisk broom where necessary to resemble dry leaves and twigs. Small forked twigs are laid flat on the top or overhanging the sides, and are held in place with a lump of cement, which, when painted, represents a stone that has rolled down the mountain and stopped at the base of a tree it has felled.

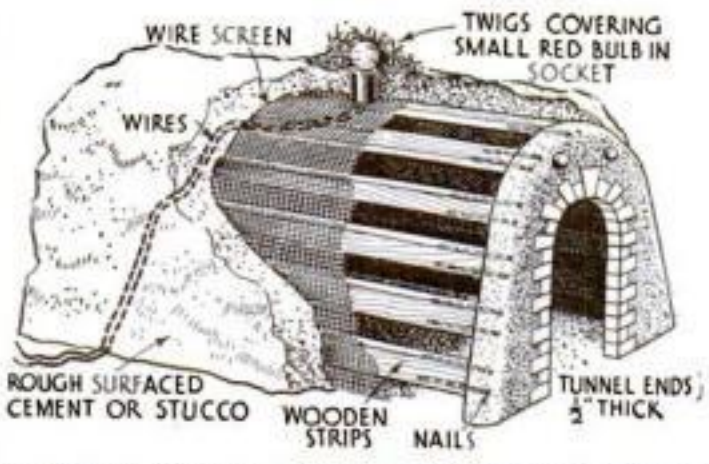
After the cement has been allowed to dry undisturbed for a few days in a cool place, a coat of varnish size is applied. While this is still tacky, daub on spots at various points with green, red, black, blue, orange, white, and as many colors as may be available. Then blend them together. Here and there tip off a high spot with pure white, and other spots with chrome yellow, to give the effect of wild flowers. The trees and bushes are painted various shades of brown and green and then tipped off with white, yellow, red, or a lighter shade of green.

A red or orange lamp is placed in the socket and covered with small twigs. When the room is darkened, this gives the effect of a fire burning on the mountain top. Lights may be placed inside the tunnel, if desired; and for signal lamps, crystal-cut red and green glass markers may be inserted in the end walls so that the light shines through them.

The ends are painted either brown or light gray, and while the paint is still wet, they are sanded with dry white beach sand. Lines may be scored with a pencil around the openings to give the effect of stone arches.

A few precautions might be mentioned. Do not attempt to hurry the drying of the cement with heat, and do not jar or even move the model while drying. Before starting the painting, let the tunnel dry until the cement has regained its original light color. If slate or stone-surfaced roofing material is used instead of wire screening, keep the rough side uppermost.

Mountain peaks with trains passing behind them may be made in the same way. An irregularly shaped back and baseboard are sawed out and nailed together at right angles, and wire screening is tacked from the bottom edge of the baseboard to the top edge and sides of the backboard. This is finished in the same manner as the tunnel, except that the miniature houses and individual trees may be omitted—HAROLD W. LONG.



General method of building a durable tunnel for a model railway. It can be modified to suit any scenic layout

BUILD THIS RECEIVER WITH METAL TUBES

(Continued from page 53)

Giving the panel a professional-looking crackle finish with a new paint which any amateur can apply

Covers for stage shields can be formed as follows: For the radio-frequency stage, an 8 by 9-inch aluminum sheet should be bent down at right angles one half inch to give a cover ½ by 7 by 8 inches. For the audio stage cover, a 7 by 9-inch sheet bent to give a cover measuring ½ by 6 by 8 inches will serve. The audio shield cover should be supplied with ventilation holes.

In selecting the parts listed elsewhere, pay particular attention to the transformers. The power transformer should be capable of delivering 400 volts, center-tapped at 200, and have a current rating of approximately eighty milliamperes. For audio amplification, the input push-pull transformer between the plate of the 6C5 to the two grids of the 6D5s should be of the conventional input push-pull type. For the output power transfer of energy, the output transformer should be of the type normally used in connection with push-pull type '45 tubes and a 1, 2, or 3-ohm dynamic speaker voice coil.

The parts required for the construction of this set are as follows:

C_1 and C_2.—Variable condensers, 140 mmf.
C_3 and C_4.—Variable condensers, 20 mmf.
C_5, C_6, and C_9.—Fixed condensers, .01 mfd.
C_7 and C_8.—Fixed condensers, 1 mfd.
C_{10} and C_{11}.—Fixed condensers, .0001 mfd.
C_{12}.—Electrolytic condenser, 25 mfd., 25 v.
C_{13} and C_{14}.—Fixed condensers, 5 mfd.
C_{15} and C_{16}.—Fixed condensers, 1 mfd.
C_{17}.—Electrolytic condenser, 8 mfd., 400 v.
C_{18}.—Dual electrolytic condenser, 8 mfd., 500 v.
C_{19}.—Fixed condenser, .0001 mfd.
R_1.—Volume control, 10,000 ohm.
R_2.—Fixed resistor, 100,000 ohm, 1 watt.
R_3.—Fixed resistor, 400 ohm, 2 watt.
R_4.—Fixed resistor, 150,000 ohm, 1 watt.
R_5.—Fixed resistor, 25,000 ohm, 2 watt.
R_6.—Fixed resistor, 10,000 ohm, 2 watt.
R_7.—Volume control, 50,000 ohm.
R_8.—Fixed resistor, 60,000 ohm, 1 watt.
R_9.—Volume control, 1 meg.
R_{10}.—Fixed resistor, 2,750 ohm, 2 watt.
R_{11}.—Fixed resistor, 60,000 ohm, 1 watt.
R_{12}.—Fixed resistor, 100,000 ohm, 1 watt.
R_{13}.—Fixed resistor, 900 ohm, 1 watt.
R_{14}.—Fixed resistor, 25,000 ohm, 25 watt.
R_{15}.—Grid leak resistor, 5 meg.
T_1.—Power transformer, 400 v., center tapped.
T_2.—Push-Pull input transformer.
T_3.—Push-Pull output transformer.
R.F.C.—Radio-frequency choke, 2.5 mh.
Ch_1.—Choke, 300 h.
Ch_2.—Choke, filter, 30 h.
L_1.—Four-prong plug-in coils.
L_2.—Six-prong plug-in coils.
Miscellaneous.—Five-inch dynamic speaker (2,500-ohm field), dial, aluminum, all-metal tubes, wire, solder, etc.

DIESELS USHER IN NEW AGE OF POWER

(Continued from page 13)

Early this spring, a series of spectacular runs at Daytona Beach, Fla., focused attention on the speed possibilities of the modern Diesel. Dave Evans and "Wild Bill" Cummins streaked along this strip of silver sand at speeds that added miles to the world's record for such machines. Powered with stock model, truck-type Diesels, Evans's machine reached 125 miles an hour and Cummins's 137 miles an hour in officially timed runs. Both racers rode to Florida from the North on Diesel-powered trucks.

A TRUCK with a Cummins engine, in mid-winter, 1933, gave one of the most remarkable demonstrations of stamina on record. Day after day, for 14,600 miles, it circled the track at Indianapolis, averaging forty-three miles an hour and traveling 10,000 miles without refueling, 13,585 without stopping the truck, and all of the way without shutting off the engine!

The same engine carried a 17,000-pound truck 3,214 miles from coast to coast in ninety-seven and a half hours at a total fuel cost of $11.22. This averages a tenth of a cent a ton mile. In addition, the Cummins engine holds the official transcontinental record for busses. In 1932, it carried a 10½-ton bus from New York to Los Angeles in seventy-eight hours and ten minutes running time. The average speed was more than forty miles an hour and the fuel bill was only $21.90.

On rails as well as on roads, Diesels are making history. The Burlington Zephyr and other streamline trains depend upon oil-burners for their power. With its 660-horsepower Winton Diesel, the Zephyr covered the 1,015 miles between Denver, Colo., and Chicago, Ill., in thirteen hours, reaching a peak speed of 112 miles an hour and clipping the normal running time in half.

While such streamline trains are a recent innovation, Diesel-run locomotives have been known since 1911. In that year, a pioneer was put in service on a railroad in Switzerland.

The spectacular advance in bullet trains has turned public attention to the accomplishments of the Diesel in other fields. At present, all but the smallest farm tractors are oil-burners. In a number of instances, the cost of fuel to run a big Diesel tractor was less than the cost of the driver's meals!

IN THE construction field, the record is just as striking. Cranes, shovels, crushers, hoists, compressors—more than thirty manufacturers are producing such equipment run by Diesel engines. On the water, ferries, towboats, yachts, and fishing craft likewise are powered by these motors. The lifeboats of the new British liner, the *Queen Mary*, will carry engines of this type.

The largest all-Diesel ship afloat is the Italian liner *Augustus*, which plies between Europe and South America. Seven hundred and ten feet long, it is registered at 30,418 tons. Close behind it are the Cunard-White Star vessels, the *Georgic* and the *Britannic*. The former is a 27,759-ton ship, the latter a 26,943-ton one. According to the latest statistics, approximately ninety percent of all tankers under construction are being fitted with Diesels.

In a host of cities, Diesels are carrying the burden at power houses, pumping stations, and sewage-disposal plants. Locks at the Panama Canal have Diesels to aid in moving the massive gates. Even on the pipe lines that carry crude oil to the refineries, Diesels force the black petroleum down the miles of steel tubes.

During the manufacture of the latest engines, the grinding of the parts is so exact that, in some cases, the workmanship can be checked only by projecting the shadow of the part on a greatly enlarged drawing.

On the skyways, the advantages of these motors is obvious. They would reduce the fuel load, remove the fire hazard, and eliminate the dangers of carburetor or ignition breakdown. The late Capt. L. M. Woolson, with his Packard Diesel—a 225-horsepower motor weighing only 510 pounds—led the way in America. Now, practically every major country in the world is seeking a perfected high-speed Diesel of the air.

Added impetus has been given to the development of Diesel-powered aircraft by rumors of the invention of a mystery-ray apparatus that would bring down planes by interfering with their ignition systems.

In line with this quest, France has just offered a prize of a million francs to the citizen who can develop a Diesel capable of meeting the requirements of a pursuit plane.

ACROSS the border, Germany is installing Diesels in the transport ships of the Lufthansa, giving them millions of miles of testing in the sky, grooming them for use in huge bombing planes which are expected to be a deadly feature of the next war. At the same time, England and America are active in the study of ignitionless engines.

In recent tests, the Junkers "Jumo," the type of Diesel installed in the multimotored Lufthansa planes, showed it could maintain 650 horsepower up to 11,400 feet. It weighs only 2.6 pounds per horsepower. In other countries, famous motor builders are producing experimental Diesels—the Sunbeam concern in England, the Fiat factory in Italy, the Clerget plant in France.

Biggest of all aircraft Diesels under construction is one reported from a midwestern factory. It is an inverted V-type engine with twelve water-cooled cylinders. Built according to the design of a Belgian inventor, it is expected to develop 1,200 horsepower.

In various parts of the United States, Diesels are taking their places beside steam turbines in producing electricity. At Tucson, Ariz., for example, coal costs approximately eight dollars a ton while fuel oil comes in tank cars at less than five cents a gallon. Here, the power plant which produces current for the city is run entirely by oil-burning Diesels.

Similarly, at Menasha, Wis., the town-owned power plant has used Diesels for twenty-five years. And it has been turning out electricity for less than two cents a kilowatt hour. In other places, utility concerns are installing the engines to carry peak loads at moderate-sized stations.

Slowly but surely, these economical, dependable power plants have been finding new uses. Now, through a spectacular advance, they are bringing nearer the long-predicted Diesel age in the world of power.

COLORS HELP PIGEONS LOCATE THEIR LOFTS

HOMING pigeons can find their lofts, particularly if they are mobile, more readily if the lofts are painted distinctive colors. This discovery, it is reported, was made at the Schofield Barracks of the U.S. Army in Hawaii. The use of distinctive colors, the Army men found, was as effective at night as during the day. Colored lights were used at night. Each loft, in addition to its distinctive coat of paint, has its own individual number and formation of colored signal lights. This color-and-light system enabled Army birds to set a world's record for night flying. Their time averaged only sixteen yards per minute slower than the day record.

FROM COAST TO COAST IN A MODERN AIRLINER

(Continued from page 28)

off—with an ear to the phones. At any second, the pilot may pick up his transmitter and instantly raise the ground operator. At no time is vigilance relaxed, even for a moment.

Here we come in contact with another of the marvels—the third pilot. You've guessed it. The third pilot is a robot, a little metal box weighing perhaps thirty-five pounds, but it is the most skillful pilot imaginable. Operating on the gyroscope principle, it guides the plane unerringly on its way, instantly correcting any deviation from its course. It is especially valuable in thick weather, leaving the pilots free to study their instruments and maps and attend to their radio.

NOW comes the most beautiful flying of all—sunset flying. The setting sun makes the ground glow, so that we appear to be flying under a great canopy. The air is still and calm. We appear to be hanging in space, as if suspended on some great invisible thread. There is no motion, and little sound except a high-pitched whistling like that of a peanut vendor's wagon. The whistling is caused by a 185-mile-an-hour gale outside the cabin, for we are hurtling through the air at more than three miles a minute.

Soon darkness falls, and tiny pin points of light flicker on the ground. Our navigation lights—a green light on one wing tip, a red on the other, and a white light on the tail—snap on. These are to warn other planes flying on the same airway.

Night—black, inky night—folds around us. The lights of little towns sparkle below us like clusters of diamonds.

To our left, we see a brilliant flash. It is repeated every ten seconds. It is one of the 2,000,000-candle-power beacons strung along the airway, five to ten miles apart. Far beyond, we can see another and another; sometimes as many as five or six are in sight at once on a clear night. They are part of the unbroken chain stretching from ocean to ocean, across the New Jersey marshes, the Allegheny woods, the prairie states, the towering Rockies.

Following each flash, there is a rapid dot-dash identifying signal in red. Every third beacon has a green light, indicating it is an emergency field, and, as we near it, we see the rectangle of boundary lights, marking the field's limits. If need be, we might land here. By switching on the two 500,000-candle-power headlights sunk into the nose of the plane, the pilot can illuminate the field and land. At any field, we would find a caretaker, a telephone, gasoline, and food.

These fields average between twenty and thirty miles apart, representing a continuous landing field from coast to coast; thus a ship flying 185 miles an hour is always within three to five minutes of a regular landing field.

AS A further safety precaution, the plane is required by law to carry parachute flares, great magnesium lights which can illuminate as much as a square mile of the earth below them as they descend.

We reel off mile after mile of inky darkness, jeweled patterns of towns, and flashing beacons. Then the flare of Gary and East Chicago mills. The dispatcher in the tower at the Chicago airport hears our motors and switches on the great floodlights. We slide to a landing 725 miles and an even four hours and forty-five minutes from New York. It takes about eighteen hours on the fastest limited trains.

Forty minutes later, after an inspection and a 385-gallon drink for the gasoline tanks, the plane is ready for the next hop. The lights of Chicago fall astern rapidly.

Up in the dark- *(Continued on page 110)*

FROM COAST TO COAST IN A MODERN AIRLINER

(Continued from page 109)

ened cabin, the pilots are using still another part of the ground organization, the part that has made bad-weather flying not only possible, but practical—the radio range. Every foot of this airway is covered by a radio range beacon, which guides our ship on its path as unerringly as the two steel rails guide the railroad train.

The range stations are 200 or 250 miles apart. Each sends out a radio beam, a narrow band composed of two interlocking radio signals, like the beam of a lantern, which broadens the farther it gets from the station. On either side of the range are broadcast constant streams of dots. At the far end of the beam, it may be several miles wide; near the station, it may be a few hundred yards wide.

SO LONG as our pilot keeps on his course, he hears nothing in his earphones but the steady stream of long dashes, guiding him on. But suppose that he edges off to the north. As soon as he drifts over too far to the right, he hears the dots breaking into his dashes, forming the code letter "N". All he must do is turn to his left until the dots fade out, and he gets the uninterrupted long dashes again.

Radio is being put to still another use—for blind landings. By use of the new equipment, the pilot is guided into position over his destination airport, when he is unable to see the ground, and then is guided onto the field unerringly and as accurately as if in bright sunlight.

But already it is 11 P.M., and we are circling to the left over Kansas City's airport, down in the Missouri River bottom, 1,135 miles from New York. Kansas City is the nerve center and the aircraft repair base. Big maintenance shops here at regular intervals work on every plane on the line.

Only mechanics licensed by the Department of Commerce are permitted to work on these ships. When a plane comes in for its periodic check-up, a printed schedule is hung over one propeller and the workmen go over it point by point, checking off each item as it is completed.

After twenty-five hours in the air, the motor covers are taken off and the engines are given a top overhaul. After 300 hours, the motors are pulled out altogether and taken apart, piece by piece. If any part shows wear, it is replaced immediately.

At the same time, the three-bladed propellers are etched with acid which will show up any flaws or traces of metal fatigue.

Soon it is time to leave. The maps show fair weather, broken only by a few small storms, all the way to Albuquerque, 762 miles away, the longest jump of the trip. Albuquerque is awake and waiting for us. We sink through the light in what the pilots call a "hot" landing, for we are in high country now and the air is thin.

IN THIS western wilderness are scattered air beacons, and emergency fields, just as thickly—possibly even more so—as in the inhabited east and the Prairie States. Some of the beacons are in such remote sections that it is not even practical to have caretakers. Astronomical clocks, regulated to allow for the seasons, turn on and off the generating engines at nightfall and daybreak. At the emergency fields, the caretakers are isolated, cut off from civilization, sometimes for weeks or months at a stretch.

It is dawn now. A gigantic ball of burnished copper rises in the East, playing kaleidoscopic tricks with the great white cloud formations and raveling wreaths of morning fog.

We are slipping lower. Houses take shape and color. As our wheels touch the Los Angeles airport, the teletypes flash the signal:

"The 'Sky Chief' landing on time."

HOME TESTS EXPLAIN HOUSEHOLD PRODUCTS

(Continued from page 51)

also be applied as a solution, which is made by dissolving a rounded tablespoon of the mixed powder in a gallon of water. A potted plant of about six-inch size should receive one gill of this solution at two-week intervals. Plants in your garden also will benefit from doses of the solution.

From milk, modern industry produces such varied products as billiard balls, medicines, jewelry, and adhesives. On a small scale, you can duplicate some of these feats of chemical magic. Skimmed milk, or milk from which the top cream has been removed, will serve as your raw material.

Dilute the milk, with water, to twice its original volume. Then add dilute hydrochloric acid—about one part of acid to four parts of water—while stirring. A precipitate will form. Let it settle, and then add more acid. If a precipitate appears again in the upper or clearer part of the liquid, still more acid will be required. Continue adding the acid until no more precipitate forms.

THE precipitate, a complex substance known as casein, must now be recovered by filtering the liquid. Filter paper will not do, because of the colloidal nature of the whole mixture, but a single layer of cheesecloth placed in a funnel works nicely. After the liquid has run off through the filter, pour copious quantities of water after it to wash impurities from the casein remaining on the cloth. Finally, rinse the precipitate with alcohol and then with ether.

The rinses with alcohol and ether, while not absolutely necessary, yield a purer and fluffier product. If they are omitted, the casein, scraped from the cloth and dried, will be hornlike because of the water and butter fat it retains. The alcohol removes the water, and the ether takes out the butter fat.

You can make a porcelainlike cement, very useful around the home and laboratory, from 100 parts of casein, five parts of water glass, and five parts of dry lime (calcium hydroxide), mixed intimately and brought to the desired consistency with water.

A quick-hardening cement may be made from 100 parts of the dry casein, twelve parts of lye (sodium hydroxide), and fourteen parts of magnesia (magnesium oxide), mixed into a paste with water. For a wood putty, rub with water 100 parts of casein, twelve parts of borax, and about twelve parts of dry lime. An adhesive preparation may be made from 100 parts of casein and about fourteen parts of borax or dry lime, rubbed to a dough with water; more water should then be added to form a workable paste. Dry mixes containing casein, which are to be mixed with water and used as adhesives at some later date, usually contain a mold-preventing substance such as sodium salicylate to act as a preservative.

FLIES BECOME ASSETS TO MUSHROOM GROWER

AN UNUSUAL method of disposing of swarms of flies was recently adopted by a mushroom grower who was confronted with a plague of flies which hatched in the manure he used as fertilizer. An engineer friend arranged the installation of a suction fan which removed the flies from the mushroom beds and passed them over refrigerating coils. The chilled and dormant flies were then allowed to drop into large milk cans. In these containers, they were shipped to commercial frog raisers. When the latter received the cans, they immersed them in a brine solution in order to chill the flies and render them dormant again. In this condition, they are fed to the frogs. Now the mushroom grower realizes nearly as much from the sale of flies as from mushrooms.

NEW SUBSTANCES FOR ART AND INDUSTRY

(Continued from page 21)

forms in every city and town. Toasters, cameras, telephones, radios, grinding wheels, bottle caps, ignition parts, door knobs, roller skates, all are made of these molded plastics.

By laminating plastics with fabric, paper, and other materials, a host of new products has been made possible. The paper-laminated stock is used for table tops, radio panels and similar articles. The linen-or canvas-laminated material is made into timing gears for automobiles and motor pinions on factory lathes. Such products are as strong as cast iron and possess the added advantages of silent operation and resistance to corrosion.

GRAPHITE is embedded in other types of laminated plastics to provide automatic lubrication when the material is employed in bearings. Graphite-impregnated cloth usually gives the lubricating character to such bearings.

In solid sheets, laminated plastics form the walls of booths and the doors in many public buildings. Recently, an eastern railroad terminal installed synthetic-resin doors throughout. Not only are they easy to keep clean and hard to scratch or mar, but they are entirely fireproof. Tests with a blowtorch showed that this material could withstand a temperature of 1,800 degrees F.

To provide special, high-speed grinding wheels for a wide variety of purposes, abrasive particles are now being bonded with Bakelite. As many as 40,000 cutting chips, tests showed, lie on the surface of an average twenty-four-inch wheel, four inches wide, made by this process. Spinning at a speed of 9,500 surface feet a minute, such a wheel would carry 75,000,000 cutting points across a given spot, in the space of a single minute. And, some wheels of this sort now operate at speeds as high as 16,000 surface feet, or three miles a minute!

Another field in which synthetic resins are forging ahead is that of paints, enamels, and varnishes.

A year ago, when the America's Cup defender *Rainbow* swept over the finish line ahead of its British rival, it was protected from the salt water and spray by several kinds of synthetic-resin paint and varnish.

Ten thousand miles away, in Australia, another boat—a tiny forty-pounder designed to ride in Sir Charles Kingsford-Smith's airplane—gave an even more dramatic exhibition of the powers of this new-type varnish. For three days, the boat was submerged in sea water. When it was brought to the surface and dried out, it had not gained a single ounce of weight. The varnish had formed an impervious coating which the salt water could not affect.

A THIRD striking demonstration occurred at Ambridge, Pa., a town not far from Pittsburgh. Here, a million-gallon water tank provided the unique testing ground for 196 kinds of coating material. The inside of the great tank was laid off into 196 vertical strips running from top to bottom. To determine the relative durability of various paints, the experts coated each strip with a different kind. At the end of a month, they examined all the panels; at the end of six months, nine months, a year, eighteen months, they examined them again. Their report, at the end of nearly two years, showed that the only paint that passed the test with a perfect score was one made with a synthetic-resin base.

Long before such plastic-base paints appeared on the market, they had survived one of the most grueling examinations ever given a new product.

Research men weathered them in sun, wind and rain; they soaked *(Continued on page 112)*

NEW SUBSTANCES FOR ART AND INDUSTRY

(Continued from page 111)

them in caustic solutions for twenty-three hours; they boiled them in water for seven hours; they sprayed them with gasoline, pounded them with hammers, exposed them to tide and salt spray, scrubbed them with strong alkali cleansers, and, finally, spun them 20,000 times in a machine filled with flying sand grains. In every test, their reports showed, the synthetic-resin paints and varnishes stood up better than similar coatings without the plastic base.

Special types of plastic paints are manufactured for houses, boats, and bridges. One quick-drying varnish is made with an oil-soluble synthetic-resin base. It is rubbed on furniture like lemon oil and permitted to harden.

Another kind of synthetic-resin varnish protects armatures on electric generators from injury by oil, gasoline, or lubricating grease. Installations so protected range from giant armatures, twice as high as a man, to midget ones designed for small grinders.

Strangest of all applications of these varnishes is one reported from an eastern museum. The skeletons of dinosaurs and other prehistoric monsters are being coated with the liquids. They have proved themselves best for protecting the remains of creatures representing life on earth hundreds of thousands of years ago.

Another new use for synthetic resins in the field of science is in holding metals for micro-analysis. The bits of material to be examined are fixed in a block of hardened Bakelite. This gives them a solid support during the work of examination.

MEDICINE, as well as metallurgy, is benefitting from applications of the new plastics. A device made of a thermoplastic substance is replacing the familiar gauze masks worn by nurses and surgeons in the operating room. Oxygen tents for hospital patients now have transparent plastic windows. X-ray operators are protected by lead-filled Bakelite. Shields to protect vaccinations, and an adhesive tape which has a plastic base that makes it unaffected by water, are other applications. Also on the list is a new protective helmet for miners, made possible by the use of light-weight plastics.

How much punishment the latest plastic substance will stand is illustrated by breakdown tests made on a mechanical counter designed for use on high-speed factory machines. At each revolution, a bronze pawl connected with a laminated-plastic ratchet wheel. For seventy days and seventy nights, the apparatus ran at the rate of 516 impulses a minute, a total of 49,000,000 impacts on the wheel. At the end of that time, it was the bronze pawl, and not the wheel, that gave out. Engineers who examined the wheel reported it was good for another 50,000,000 impacts!

Not infrequently, the manufacturers of plastic substances have to develop special formulas to meet the needs of a particular product. For example, when broadcasts from electrical recordings came into wide-spread use, one of the largest producers of the records appealed for a new material that would eliminate squeaks. The engineers and chemists of a plastics laboratory immediately set to work. They solved the problem, developing an entirely new material.

Most of the thousands of new uses for plastics have been found in the last decade. The greater number of synthetic substances now making industrial history have been born since the World War. The field is new. But it is a field of spectacular accomplishments, of amazing possibilities. It represents a crowning achievement of the industrial chemist.

GUS GIVES A LESSON IN CAREFUL DRIVING

(Continued from page 56)

driving. You know the kind of a fellow I mean. The bird who barges across a blind crossing because he thinks there's not much chance that a car will be coming the other way; the dumb-bell who starts on a long drive with poor brakes because he's willing to take a chance that he won't have to stop quick; the fellow who cuts around a curve on the wrong side of the road, or passes another car when he can't see what's coming, because he thinks there isn't much chance of a car coming the other way—and that his luck will save him if there is."

"I see the point there, all right," Montrose admitted. "It's the gambler's instinct you should leave at home when you go out in the car."

"That's it, exactly," said Gus. "If you never gamble on what the other fellow is going to do, you'll be ready for him no matter what fool stunt he pulls."

"Always seemed to me speeding causes a lot of accidents, too," Montrose ventured.

"THAT all depends on what you mean by speeding," Gus replied. "You can run a chance of landing in jail on a homicide charge when you are driving only twenty miles an hour, and yet you may be as safe at twice that speed as you would be at home in bed. It all depends on the time and place."

"How do you figure that out?" Montrose wanted to know.

"Have you an hour to spare?" Gus asked. "If you have, drive over with me to Carville while I do an errand, and I'll show you what I mean."

Montrose readily agreed, and the two men climbed into Gus's car.

"Now," said Gus, as they turned into a wide state road, "this stretch is over four miles long, with no sharp bends or concealed turns. There are only two entering roads, and you can see a car coming on either of them nearly a quarter of a mile away. There's no doubt but what this road is safe for forty miles an hour. Of course, there's drivers would say it was safe for sixty, but there's no satisfying that type. If you made the road really safe for sixty, they'd want to do a hundred.

"Of course," Gus went on as the speedometer needle crept up to forty, "this speed is really safe only if the tires on your car are good, the steering gear is tight and in perfect shape, and the brakes are right. On the other hand, a fellow was nearly killed last year on this road because he was going too fast. He was only doing forty miles an hour, and he had the road all to himself, too."

"What happened—a blow-out?" Montrose inquired.

"Nothing gave way on the car," said Gus. "He was blown off the road! You see there were some icy spots on the concrete, not enough to cause any trouble, ordinarily, but there was a sixty-mile gale blowing, quartering across the road, and as he hit an icy spot an extra hard blast started the car into a skid that ended out there in the field with a busted spring and a damaged mudguard. It sure was lucky for him it happened right there rather than farther along where there's a bank he'd have gone over."

"BLOWN off the road by the wind!" exclaimed Montrose. "I wouldn't have believed it possible that wind pressure could do anything like that."

"It did, just the same," Gus maintained, "and if you don't believe that a 100-mile-an-hour breeze packs a punch, just get caught in one of those Kansas 'twisters' and see what happens to you."

"So the answer is to watch your step on a windy day if there's *(Continued on page 113)*

GUS GIVES A LESSON IN CAREFUL DRIVING

(Continued from page 112)

any chance of slippery spots on the road. I'll make a note of that one," said Montrose.

"Here," said Gus, "is where you see the other side of the speed story." They had turned into a narrow street through the densely populated outskirts of Carville. School had just closed, and children of all ages were thronging the streets.

"Twenty miles an hour would be too fast through here, right now," said Gus as they crawled along at a bare twelve miles an hour, "and you've got to keep your eyes peeled and your foot on the brake every second, in case some youngster darts across in front of you. Yet, you could sail through here at thirty miles an hour in perfect safety at two o'clock in the morning. So you see you can't say offhand that any particular speed is safe or not safe till you know all the circumstances."

"I hadn't thought of it before, but the time of day *would* make a lot of difference," the passenger agreed.

"You bet it does," nodded Gus. "Figures show that the most accidents happen between five in the afternoon and eight in the evening. Twilight coming on, people hurrying home from work, kids out joy riding, everybody a little tired after the day's grind—everything seems to work together at that time of day."

GUS soon finished his business in Carville and headed for home.

"I suppose slippery roads and rainy weather cause a lot of accidents," Montrose volunteered, as the car picked up speed in the open country.

"Well, that's a funny thing," replied Gus. "Of course, slick asphalt or a heavy fog makes driving a lot more dangerous, and does cause accidents. Yet, I was reading, just last night, that four out of five fatal accidents happen on dry roads and in clear weather."

"Well," said Montrose, as they pulled up at the Model Garage, "it looks to me as though the whole problem of safe driving can be boiled down to a mighty simple rule and that is: Never take a chance on either your car or your driving; be sure, and you'll never be sorry—or worse!"

"That's the whole thing in a nutshell," Gus agreed, "and if the police departments can ever get every driver to paste that idea in his hat and stick to it, there'll be so few accidents that the cost of liability insurance will drop to the price of a new tire."

"That won't mean a thing to Rummy Dunkins," laughed Joe, as Montrose drove off. "He should worry! They say Providence always watches over fools and drunkards!"

"Not when the drunk is behind the wheel of an automobile!" grunted Gus as he started work on the next job.

COMMON CHEMICAL KILLS ONION AND GARLIC ODOR

LOVERS of onions and garlic may now indulge their taste and none will guess their secret, as a result of recent discoveries by Yale University physiologists. The persistence of these odors in the breath, which had hitherto mystified scientists, was found to be due to aromatic substances known as essential oils that cling to the surfaces of the mouth, tongue, and teeth after eating.

An instant and effective remedy, the experimenters found, was to wash the teeth and tongue and rinse the mouth with a solution of chloramine, a chemical available at drug stores. The chlorine liberated by the solution, made by dissolving one 4.6 grain tablet for each fluid ounce of water, reacts chemically with the essential oils and deodorizes them.

THE BUILDER OF THE FLYING TRAPEZE

(Continued from page 35)

and less dependable iron pipe which show people had traditionally used.

For the "iron-jaw" or teeth act, Van Wyck conceived the idea of a rigging on which two or three persons might hang simultaneously by their teeth and revolve for a "human-butterfly" effect. And he has originated variations of the act.

His latest contribution to the circus art is an aerial contrivance so constructed that three women perform on swinging ladders which revolve around a stationary trapeze on which a fourth performer goes through a routine of acrobatic feats.

STRANGELY enough, most of the Japanese perch poles used by performers from the Orient are made in Van Wyck's shop. So are the Roman ladders used by Italian equilibrists, the juggling guns of French Zouaves, the bounding ropes of East Indian acrobats, and the Australian boomerang-throwers' weapons.

A Japanese acrobatic troupe came to Van Wyck's shop in Cincinnati with an order for equipment to be used in their act. "I told them I was too busy to make their rigging," Van Wyck said. "Then they asked permission to use my machinery to make their own props and I readily agreed. They set to work, and I have never seen better craftsmen. Further, every time they left a pile of steel filings or sawdust on the floor, they stopped work to sweep up the mess."

Because he has been a performer himself, Van Wyck understands thoroughly the individual problems of circus people. That is why they come to him from all parts of the world, confident of his ability to provide what they need. He knows that certain rigging must be perfectly balanced or it will be useless for the purpose desired. He knows where the greatest strain is exerted on various kinds of apparatus. And he never forgets that circus equipment must be attractive in appearance as well as serviceable.

"Many people think," he said, "that there is a trick to every circus act—that equipment is so constructed as to make it easy for a performer to do apparently difficult feats. Unfortunately, perhaps, circus rigging cannot be made like a magician's properties."

It is true, he explained, that circus equipment is built to aid a performer in doing his particular type of act. Few are the artists, however, who do not risk their lives every time they mount their rigging. A trapeze bar on which an aerial performer does heel-and-toe catches, for instance, has ornamental balls on the ends of the bar, which are loaded to make the bar swing evenly and permit better balance than on an ordinary trapeze. The artist also wears specially made shoes with padded humps built up behind each heel—but Van Wyck points out that a half-inch pad is not a very substantial safety device when a performer does a twisting somersault out of a trapeze to catch by his heels.

ONE of the most spectacular acts in the circus program is that of the tight-wire artist. Yet a tight wire is about the simplest piece of equipment made in the shop. Van Wyck constructs all of the wires used by Con Colleano, the Australian artist, who is the only person who has ever accomplished a forward somersault on the steel strand.

When Colleano needs a new wire, Van Wyck selects a strand of one-fourth-inch English steel, thirty-seven feet long and tested to bear the weight of four persons. Each end of the wire is bent around a cast-iron eyelet, triangular in shape and cast in one of the manufacturer's homemade molds. The loop around the eyelet is made fast by binding with fine copper wire which is solidified by cold soldering, and the finished product is ready for the arena.

"Cold soldering is necessary to prevent the drawing of the temper from the steel," Van Wyck explains. "This is important because, if the wire was heated, it would be subject to crystallization, which changes the finest steel into mere pot metal. Crystallization in metals is the greatest menace to the circus performer."

THE life of a tight wire depends upon the strain to which it is subjected. Colleano discards his wires every six months because of the strain of his bounding on the strands to obtain momentum for his mid-air revolutions. "On the other hand," Van Wyck added, "a tight-wire walker came to my shop the other day and boasted that he was still using a wire I made for him seventeen years ago."

"You're crazy to risk your life on that wire, I told him. I explained the danger of crystallization and he said he had never thought of it. So he ordered a new wire."

And that, Van Wyck said with a wry smile, is one of the drawbacks of his business. He makes equipment so durable that his products rarely wear out. The revolving globe on the spinning trapeze, which he made for Ed Millette more than a quarter of a century ago as one of his first contributions to the circus, is still being used every day by Ira Millette, who succeeded his father in the head-balancing act.

About the most difficult circus property to make, in Van Wyck's opinion, is a rolling globe. Such a globe, a perfect, hollow sphere of white pine, is usually twenty-seven to thirty-six inches in diameter. The performer balances on the curved surface, rolling the globe up and down inclines, while doing other feats with his hands, such as juggling or hand-to-hand balancing with a partner.

A globe is constructed in two sections, fashioned inside and outside on a lathe and the interior covered with canvas, glued to the surface. The two sections are glued together and the completed globe thoroughly sanded and painted in gay circus colors. Two weeks of exacting work are required to turn one out.

Increasing use of cleverly contrived mechanical devices to aid in the performance of sensational feats is predicted by Van Wyck as he looks into the future of the circus. He points out that gymnasts in almost every field of ground and aerial acrobatic work have achieved the heights of mere physical strength, endurance, and agility.

TWO of the most sensational acts of the modern circus, he remarked, were made possible only through mechanical devices. One is the shooting of two men, one after another, from a gigantic cannon by the use of compressed air. Another is the feat of a French woman who leaps from a platform high in the tent to a trapeze which breaks, plunging her toward the ground. Wires attached to her ankles and to springs on the high platform from which she leaps, snap her back into the air to swing pendulum fashion, leaving the audience gasping.

Even the clowns, who once depended solely upon comic songs and later upon pantomime for laugh-provoking effects, have turned to mechanical contrivances. The driverless automobile which cavorts on the hippodrome track to the delight of the kiddies, and trick bicycles which expand and shrink in size as the comedian pedals, are among the ingenious devices that are seen in the modern circus.

The ingenuity of the circus mechanic is cast in the big unseen role of the thrilling acts of today.

HERE'S THE ANSWER

(Continued from page 55)

has no bearing on the plant's location with reference to the equator. For example, the common hop and certain honeysuckle plants twine clockwise (viewed from above) while the morning glory and common bean twine counterclockwise. These plants maintain the same twining characteristics north and south of the equator. The direction of the twist is probably determined by geotropic stimuli and other plant forces not yet fully understood.

Rise and Fall of Bubbles

Q.—WHY does a soap bubble rise in the air when you first blow it and later sink, if it does not break?—F. B. B., Salem, Oregon.

A.—YOUR breath which blew it was warm and warm air is lighter than cold. As the air in the bubble cools, the bubble becomes heavier and settles to the ground.

A Great Skin Discovery

Q.—ARE bones and fossils the only remains that have been found of prehistoric animals? —A. C., Frederick, Md.

A.—EXCAVATING recently in Wyoming, the American Museum—Sinclair Expedition found great quantities of patches of skin of sauropods (a branch of the dinosaur family). This find is remarkable because the delicate organic skin substance had been preserved for about 140,000,000 years.

These Old Bugs Step Out

B. T. H., EAST CLEVELAND, OHIO. The seventeen-year cicada is probably the longest lived of all insects. After they are hatched, they burrow into the ground and attach themselves to tree rootlets. Here they remain, quite motionless, for seventeen years, getting their nourishment from the tree's sap. At the end of this period, they emerge and climb a tree, their skin-encasements split, and the mature cicadas have a brief but noisy adult life of about five weeks.

When Gold Takes Back Seat

Q.—WHAT material commands the highest commercial price on the world markets today?—M. O. V., Albany, N. Y.

A.—EXCLUDING all items whose values have been enhanced by skilled workmanship and those of great historical or sentimental value, radium is the most costly material in the commerce of the world. It commands a price in excess of $2,000,000 a troy ounce, which makes it worth about 60,000 times its weight in gold at present standards.

Flights of Flying Fish

M. F. T., TAMPA, FLA. The duration of most of the flights of flying fish, according to recent observations by Carl I. Hubbs of the University of Michigan, are short, lasting only one or two seconds. The longest single flight this authority observed lasted only thirteen seconds; the longest compound (successive leaps) slightly less than thirty seconds. Perhaps the record compound flight actually timed is one of forty-two seconds, recorded by a sea captain.

F. or C., It's Forty Below

Q.—IS THERE any temperature point at which both the Fahrenheit and centigrade readings would be the same?—H. A. B., Boston, Mass.

A.—WHEN it is forty degrees below zero, the temperature readings on both the Fahrenheit and centigrade scales are the same. This is the only temperature at which you need not specify which kind of thermometer you mean.

Guarding Against Jungle Diseases

(Continued from page 15)

further sidelights on the part animals play in spreading disease. I learned that great epidemics may be predicted by watching the behavior of animals. In India, for example, the deadly bubonic plague makes its appearance first among rats and other rodents. Infected fleas from these rats spread the disease by biting people, and the epidemic is on.

Not long ago, Public Health Service doctors at Los Angeles harbor conducted a "flea census" to analyze possible plague conditions there. Hundreds of traps were set at selected points in the harbor. The rats were chloroformed, if still alive, then held over a pan of water while a comb was run through their fur. Fleas thus collected were examined under a microscope, classified, and a "plague map" made showing the location of danger points.

ALL birds of the parrot family now must be kept in quarantine fifteen days before they may enter the United States, to guard against the entry of psittacosis, or parrot fever. Many animals are subject to stringent regulations, for infection of our domestic animals invites an outbreak of the disease among men. For example, the strange undulant fever, first noted among goats on the Mediterranean island of Malta, has appeared in the United States among cows, whose milk, containing the *brucella abortus* germ, spread the infection widely among human beings.

Federal port regulations require that all vessels fend off four feet from the dock so that rats can not jump from or to the ships. Large, circular shields must be slipped on all mooring cables to prevent rats from leaving or boarding ship, tight-rope fashion. Gangways must be lighted at night. Yet, in spite of all these precautions, and even though modern marine architecture is eliminating the double bulkheads and pipe channels which make convenient nesting places, rats and insect life still exist aboard some ships.

When rodent plagues rage in foreign ports, all vessels from these cities are suspected. Whenever it is deemed necessary, a vessel is fumigated. At Los Angeles harbor, I watched fumigating experts as they battened down the hatches of a freighter just arrived with a cargo of corn from Buenos Aires. Although no traces of rats could be found by inspectors, it was necessary to fumigate the ship thoroughly because Buenos Aires was a "quarantine port", plague having been detected there.

Ventilators were plugged with canvas, and masked men released clouds of poisonous gas into the tightly closed hold of the vessel. Workers operating in pairs, with no man ever out of sight of another, strewed small circular disks emitting cyanide gas through each compartment of the vessel. A little tear gas had been mixed with the deadly cyanide to warn against leakage of the masks.

AFTER the hold had apparently been well ventilated to clear it of cyanide gas, the chief fumigation officer and the ship's first mate made a tour of inspection but not until after a cage of white rats had been lowered as sensitive indicators of remaining gas fumes. No rats were visible—only dead cockroaches on galley floors. No disease-bearing creature could have lived through that barrage of lethal gas.

Despite the vigilance of the U. S. Public Health Service and the strong barriers it has set up, I now realized that we must depend more and more on our research workers to combat the danger of epidemics presented by fast transportation from tropical countries. In the days of slow steamships, the disease germs had time to incubate within their hosts and thus betray their presence by characteristic symptoms of illness. Today infected persons or animals can arrive from the tropics days before they themselves know they are sick or the disease can be detected by doctors.

In San Francisco is the Pacific Institute of Tropical Medicine and its director is Dr. Alfred C. Reed. Within this organization, men and women daily push forward in their laboratory quest for more knowledge to thwart the ravages of these disease germs and from this headquarters, more research workers go into the tropics to carry on the fight.

"How can we keep our own bugs healthy? That's our biggest problem in the war against invading infection," said Dr. Reed. "If we can prevent these maladies from becoming entrenched among our insect population, we can handle the human problem.

"Already," he continued, "we have some of the tropical diseases here on as big a scale as in the tropics themselves. Certain sparsely inhabited desert sections of California, where bubonic plague is raging among ground squirrels and desert rats, rank with the Ganges River valley, the Uganda province of Africa, and parts of Siberia and China, as one of the major plague centers of the earth. Luckily, people in this area are few, else bubonic plague might sweep the country with catastrophic violence. The menace is merely dormant; no one knows when it may break forth.

"Other tropical diseases that lately have fastened themselves upon the United States, are bacillary dysentery, amoebiasis, trichinosis, pellagra, beriberi, undulant fever, and coccidial granuloma. Still others, particularly the baffling and fatal Chagas disease, are moving steadily northward from the tropics."

TROPICAL jungles abound with countless varieties of microörganisms—bacteria that produce horrible diseases; parasites that bore through the skin and into vital organs; poisonous fungi that grow in the lungs and cause lingering death. They teem with numberless stinging, biting, and sucking insect battalions, known to have spread disastrous epidemics throughout history.

From the tropics, valiant experimenters have brought many of these pests to be studied in the laboratory. Here I met Dr. Herbert G. Johnstone, busily engaged in research with the parasite causing onchocerciasis, the blinding disease caused by the swamp mosquitoes of Central America.

In an adjoining laboratory, Dr. Fae Donat Wood was risking death in her work with a malady for which no cure is known to science. It is the Chagas disease, similar in some respects to the terrible African sleeping sickness but instead of causing sleep, the disease organisms penetrate the heart, the spinal cord, or the brain with devastating effects upon the victim.

THE parasite is a tiny, one-celled protozoan carried by the "kissing bug"—a bloodsucking insect which lives in the nests of wood rats, opossums, and armadillos. This bug is one that might easily be carried by airplanes or automobiles coming from the tropics. Tourists often bring in armadillos as pets, and now and then, a young opossum is found in American fruit markets, curled up in a bunch of bananas.

In her research with the Chagas disease, Dr. Wood went out into the field, looking for American bugs that might be carriers of the disease. She found the "kissing bug" in all parts of the western United States. Other closely related bloodsucking insects, such as bedbugs, are common to all parts of the country. Each is a potential carrier of the disease—although not yet infected.

Fighting against the possible introduction of this menace first noted in Brazil and now established in Panama and Honduras, Dr. Wood is patiently working in her laboratory. She risks infection a dozen times daily while handling insects and white mice infected with this incurable disease.

With cultures of the parasites, grown on bits of embryonic heart tissue, she tests the action of various drugs. Already she has found one that will kill the parasite. Will it also kill the animal whose body harbors the parasite? The answer, soon to be obtained by further experiments, will show whether or not she has found a cure that will wipe out this dreaded disease.

FROM the institute, a part of the University of California's medical school, research workers have gone to all parts of the world to combat leprosy. Recently a dozen doctors went into the jungles of New Guinea where the disease had been introduced by Chinese and Hindu immigrants, attracted by the discovery of gold five or six years ago. Meanwhile, pharmacists at the institute, cooperating in the leprosy research, succeeded in extracting a powerful drug from the berries of certain Asiatic plants—a substance known as Na-dichaulmoogryl-B-glycerophosphate. This drug may prove to be a potent aid in fighting the disease which every year condemns thousands to a living death.

Long before baffling tropical diseases, borne by advancing insect hosts or by ships of commerce, can begin to take toll of American life, these vigilant guardians have made preparations to meet the problems. The American Academy of Tropical Medicine is planning to form a foundation, backed by financial leaders of the country, to attack this growing menace on every front. The daring and effective research now being carried on in a few laboratories of the country will be augmented to a strength that no horde of insects or parasites can withstand.

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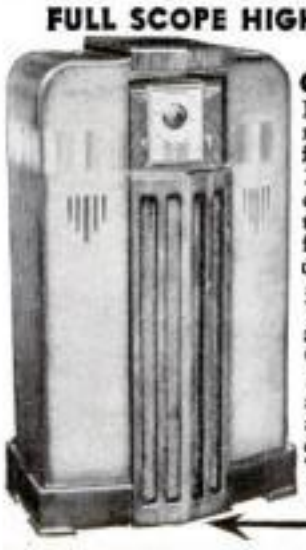

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